

All-in-one Liquid-cooled Hybrid Cabinet ECO-B261LP-2H User Manual



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1. Overview

1.1 Main Contents of the

This manual primarily covers the ECO-B261LP standard liquid-cooled energy storage system, including product specifications, transport, installation, operation, maintenance and troubleshooting. Before using this product, please read this manual carefully and operate the energy storage system in accordance with the methods described herein; failure to do so may result in damage to the equipment or personal injury.

1.2 Intended Audience

This manual is intended for personnel involved in the transport, installation and other operations of this product. Personnel must meet the following requirements:

- Proficiency in electrical, electronic and mechanical engineering; the ability to interpret electrical schematics and structural drawings
- Understanding of products, fundamental knowledge, operating principles and control logic within the energy storage industry
- Hold a professional electrician's licence and qualifications recognised by the law in the region where this product is used, and be familiar with the relevant laws and regulations in that region
- Possess the ability to handle emergency situations and manage incidents in accordance with the laws and regulations of the region where this product is used
- Be thoroughly familiar with the contents of this manual, possess professional technical skills and a high sense of responsibility
- This manual contains important information; please read it carefully before operating or maintaining the system
- Please keep this manual together with other documentation included with the product components to ensure that operators and maintenance personnel can consult it promptly.

1.3 Definitions of Warning Symbols in the Manual

To ensure the personal safety and protect the property of users whilst using this product, and to improve the efficiency of use, these manual details relevant information and includes relevant symbols to enhance the explanations.

The "Danger", "Warning", "Caution" and "Note" items in this manual do not represent all safety requirements that must be observed; you must also comply with relevant international, national or regional standards, as well as industry practices. The Company accepts no liability for any consequences arising from a breach of safe operating requirements or a breach of safety standards relating to the design, manufacture and use of the equipment.

The following symbols may appear in this document, with the meanings set out below:

Symbol	Explanation
	Used to warn of an immediate hazard which, if not avoided, will result in death or serious personal injury
	Used to warn of a potential hazard which, if not avoided, could result in death or serious personal injury
	Used to warn of a potentially hazardous situation which, if not avoided, could result in moderate or minor personal injury
	Used to convey safety warnings regarding equipment or the environment; if not avoided, these may result in equipment damage, data loss, reduced equipment performance or other unforeseeable consequences. "Caution" does not refer to personal injury
	Indicates supplementary information in the manual, emphasising or supplementing the content; it may also provide tips or tricks for optimising product use, helping you resolve a specific issue or save time
	This symbol indicates that the product contains high voltage; touching it may result in an electric shock
	This symbol indicates a high-temperature hazard at this location; avoid contact to prevent personal injury
	This symbol indicates that this part of the product is a protective earth (PE) connection. A ground wire must be connected securely and reliably to ensure the safety of the operator

	This symbol indicates that this part of the product must not be opened; opening it without authorisation poses a serious risk
	This symbol indicates that touching this part of the product is prohibited; unauthorised contact may cause equipment failure and poses a significant risk

1.4 Definitions

No.	Item	Definition
1	Cell	Battery cell
2	PACK	Liquid-cooled battery pack
3	RACK	Battery cluster, a battery system comprising multiple battery packs and a high-voltage box
4	BMS	Battery Management System
5	BMM	Level 1 BMS: Slave unit of the Battery Management System
6	BCM	Secondary BMS: The master control unit of the Battery Management System
7	EMS	Energy Management System
8	SOC	State of Charge

2. Safety instructions

2.1 Safety Instructions

Please strictly adhere to all safety regulations set out in this product manual. To prevent potential personal injury or property damage during the use of this product, and to maximise its service life and operational efficiency, please ensure you read all safety regulations carefully.

The Company shall not be held liable for any of the following circumstances or their consequences:

- Damage to the equipment caused by earthquakes, floods, volcanic eruptions, mudslides, lightning strikes, fires, war, armed conflict, typhoons, hurricanes, tornadoes, extreme weather conditions or force majeure
- Operation outside the conditions specified in this manual
- Installation and operating environments that do not comply with relevant international, national or regional standards
- Installation or use of the equipment by unqualified personnel
- Failure to follow the operating instructions and safety warnings provided in the product and documentation
- Unauthorized disassembly, alteration of the product, or modification of the software code
- Damage caused by transport carried out by you or a third party acting on your behalf
- Damage resulting from storage conditions that do not meet the requirements specified in the product documentation
- Damage caused by materials and tools provided by you that do not comply with local laws, regulations and relevant standards
- Damage caused by your or a third party's negligence, wilful misconduct, gross negligence, improper operation, or reasons not attributable to the Company

2.2 Operator Requirements

Operators must meet the following requirements:

- Only professionally qualified electricians (including qualified professionals and trained personnel) may operate and maintain this product, and they must be equipped with a full set of professional electrical tools
- Be capable of assessing assigned tasks and identifying potential hazards
- Be able to provide immediate first aid to injured personnel
- Be familiar with the relevant maintenance standards for the product
- Comply with local laws, regulations, and standards
- Personnel working in special scenarios, such as electrical operations, work at height, or the operation of specialised equipment, must hold the special operating qualifications required by the relevant country or region

The warning is as follows:

Symbols	Explanation
	Live work is strictly prohibited during installation. Do not install or remove cables whilst they are live. When cable conductors come into contact with live conductors, arcing, sparks or fire/explosions may occur, which could result in fire or personal injury
	When equipment is live, improper or incorrect operation may cause fire, electric shock or explosion, resulting in personal injury or property damage
	During work, it is strictly prohibited to wear watches, bracelets, bangles, rings, necklaces or other conductive objects to avoid electric shock or burns
	Specialised insulated tools must be used during operations to prevent electric shock or short-circuit faults; the insulation voltage rating must comply with local laws, regulations, standards and specifications
	During work, dedicated protective equipment must be used, such as protective clothing, insulated footwear, safety goggles, hard hats and insulated gloves

2.2.1 Personal Protective Equipment (PPE)

According to the ‘Maximum Power Method’ in NFPA 70E, the estimated DC arc flash incident energy at the maximum power point can be calculated to determine the hazard boundary.

PPE is determined by the incident energy, which is the temperature generated by the arc flash (measured ^{in cal/cm²}) (typically at a distance of 18 inches); this energy is less than 1. Therefore, the PPE requirement for battery rack operation precautions is Category 1.

0 cal/cm ²	4 cal/cm ²	8 cal/cm ²	25 cal/cm ²	40 cal/cm ²
PPE CATEGORY 0	PPE CATEGORY 1	PPE CATEGORY 2	PPE CATEGORY 3	PPE CATEGORY 4

2.2.2 First Aid Measures

In the event of an electric shock incident, first aid and emergency measures must be implemented promptly and in accordance with established procedures:

- Immediately disconnect the relevant DC/AC circuit breakers (e.g. battery cluster switches, PCS input/output switches, main control circuit breakers, etc.)
- If power cannot be disconnected quickly, use insulated tools (such as a dry wooden stick, rubber gloves or insulated pliers) to separate the victim from the power source
- Cover the electrical burn wound with clean gauze or sterile dressings, and seek medical attention as soon as possible

2.3 Electrical Safety

The warning is as follows:

Symbol	Description
	Before making any electrical connections, ensure that the equipment is undamaged; otherwise, there is a risk of electric shock or fire
	When the equipment is live, improper or incorrect operation may cause fire, electric shock or explosion, resulting in personal injury or property damage
	During operation, prevent foreign objects from entering the equipment; otherwise, this may cause short circuits, equipment failure or damage, reduced power supply to the load or power loss, as well as personal injury

	For equipment requiring earthing, the protective earth wire must be installed first during installation; when dismantling the equipment, the protective earth wire must be removed last
	Cables must not pass through the equipment' s air inlets or outlets

2.3.1 General Requirements

The following requirements must be met:

- Installation, operation and maintenance must be carried out in accordance with the sequence of steps outlined in the manual. Do not modify, add to or alter the equipment without authorisation, and do not change the installation sequence without authorisation
- Permission must be obtained from the relevant national or regional electricity authority before the system can be connected to the grid
- Comply with power station safety regulations, such as the system for operating permits and work permits
- Install temporary fencing or warning ropes in the work area and display ‘No Entry’ signs; unauthorised personnel are strictly prohibited from entering
- Before installing or removing power cables, the equipment itself and the upstream and downstream switches must be disconnected
- If liquid is found to have entered the equipment, switch off the power immediately and do not continue to use the equipment
- Before operating the equipment, carefully check that the tools used meet the requirements and record them in the register; after operation, collect them all to ensure none are left inside the equipment
- Before installing power cables, ensure that the cable labels are correct and that the cable terminals have been properly insulated
- Once installation is complete, ensure that all protective covers, insulating sleeves and other devices for electrical components are in place to avoid the risk of electric shock
- If the equipment has multiple inputs, all inputs must be disconnected; the equipment may

only be operated once it has been completely de-energised

- When maintaining electrical or distribution equipment downstream of a power supply unit, the corresponding output switch of the power supply unit must be disconnected
- During equipment maintenance, hang a ‘Do Not Close’ sign on the upstream or downstream switches or circuit breakers and display warning signs to prevent accidental connection. Power may only be restored once the fault has been fully rectified
- When carrying out fault diagnosis and troubleshooting, if power must be cut off, the following safety measures must be completed: power off → test for voltage → install earthing leads → hang warning signs and erect barriers
- Please regularly inspect the terminal screws on the equipment to ensure they are tight and secure
- If cables are damaged, they must be replaced by qualified personnel to avoid risks
- It is strictly prohibited to alter, damage or obscure the labels and nameplates on the equipment; labels that have become illegible due to prolonged use must be replaced promptly
- Do not clean the internal or external electrical components of the equipment with water, alcohol, oil or other solvents

2.3.2 Electrostatic Protection Requirements

The accumulation of static electricity may cause electric shocks, fires, explosions, and the failure or damage of electronic components. As the energy storage system contains circuit boards and other electrostatic-sensitive components, effective electrostatic protection must be implemented to prevent or minimise the risks associated with static electricity. This involves suppressing the generation of static electricity, accelerating its dissipation, and neutralising static charges. Static electricity generated by the human body can damage electrostatic-sensitive components on circuit boards. Preventive measures include, but are not limited to:

- When handling equipment, prior to touching circuit boards, modules with exposed circuit boards, or specialised integrated circuit chips, please adhere to electrostatic protection

guidelines. You should wear anti-static workwear and anti-static gloves or wrist straps, ensuring that the other end of the anti-static wrist strap is properly earthed

- During component replacement, all components not yet installed should be kept in packaging bags with anti-static shielding properties, whilst temporarily removed components should be placed on anti-static foam pads; Removed circuit boards or modules must be packaged using anti-static packaging materials before storage or transport
- Do not touch components, solder joints, pins or exposed circuits with your hands

2.3.3 Environmental Requirements

- The following requirements must be met:
- The temperature and humidity conditions for equipment storage must be suitable; equipment must be stored in a clean, dry, and well-ventilated area, protected from dust and condensation
- It is strictly prohibited to install or operate equipment outside the ranges specified in the technical specifications, as this will affect equipment performance and safety
- It is strictly prohibited to install, use or operate outdoor equipment and cables (including but not limited to moving equipment, operating equipment and cables, plugging or unplugging signal interfaces connected to the outdoors, working at height, outdoor installation, opening doors, etc.) during adverse weather conditions such as thunderstorms, rain, snow or winds of force 6 or above
- It is strictly prohibited to install the equipment in environments containing dust, smoke, volatile gases, corrosive gases, radiation such as infrared rays, organic solvents, or excessive salt content
- It is strictly prohibited to install equipment in environments containing conductive metallic dust or magnetic dust
- It is strictly prohibited to install the equipment in areas prone to the growth of microorganisms such as fungi and mould
- It is strictly prohibited to install the equipment in areas subject to strong vibrations, sources of loud noise, or strong electromagnetic interference

- The site selection must comply with local laws, regulations and relevant standards
- The ground at the installation site must be firm, free from soft soil, weak soil or other adverse geological conditions such as subsidence. It is strictly prohibited to select low-lying areas prone to water or snow accumulation; the site's ground level must be higher than the historical maximum water level for the area
- Under no circumstances should the equipment be installed in locations where it could be submerged by water
- If the equipment is installed in an area with dense vegetation, in addition to routine weeding, the ground beneath the equipment must be hardened, for example by laying concrete or gravel
- During installation, operation and maintenance, any accumulated water, ice, snow or other debris on the top must be cleared before opening the door to prevent debris from falling into the equipment
- When installing the equipment, ensure that the installation surface is solid and meets the equipment's load-bearing requirements
- Once installation is complete, remove all empty packaging materials from the equipment area, such as cardboard boxes, polystyrene, plastic and cable ties

The warning notice is as follows:

Symbols	Explanation
	It is strictly prohibited to place the equipment in an environment containing flammable or explosive gases or vapours; no operations are permitted in such environments
	It is strictly prohibited to store flammable or explosive items in the vicinity of the equipment
	Do not place the equipment near heat sources or sources of ignition, such as fireworks, candles, heaters or other heat-generating equipment; exposure to heat may cause damage to the equipment or result in a fire
	The equipment must be installed in an area away from liquids; it must not be installed beneath water pipes, air vents or other locations where condensation is likely to form; it must not be installed beneath unit inlets, ventilation

	openings, or cable access hatches in the equipment room where water leakage is likely, to prevent liquids from entering the equipment and causing malfunctions or short circuits
	While the equipment is in operation, do not block the ventilation openings or cooling system, nor cover them with any objects, to prevent damage to the equipment or a fire caused by high temperatures

2.4 Battery Safety

The warning is as follows:

Symbol	Explanation
	It is strictly prohibited to short-circuit the positive and negative terminals of the battery, as this will cause a short circuit. A short circuit in the battery will instantly generate a high current and release a large amount of energy, causing battery leakage, smoke, the release of flammable gases, thermal runaway, fire or explosion. To avoid short-circuiting the battery, maintenance must not be carried out whilst the battery is charged
	Do not expose the battery to high-temperature environments or in the vicinity of heat-generating equipment, such as direct sunlight, open flames, transformers or heaters. Overheating of the battery may cause leakage, smoke, the release of flammable gases, thermal runaway, fire or explosion
	Batteries must not be subjected to mechanical vibration, dropping, impact, penetration by hard objects or pressure shocks, as this may result in battery damage or fire
	Under no circumstances should the battery be disassembled, modified or damaged (e.g. by inserting foreign objects, applying external pressure, or immersing it in water or other liquids), as this may cause leakage, smoke, the release of flammable gases, thermal runaway, fire or explosion
	Under no circumstances should the battery terminals come into contact with other metal objects, as this may cause overheating or electrolyte leakage
	Using or replacing the battery with an incorrect model poses a risk of fire or explosion. Please use the battery model specified and recommended by the manufacturer
	Battery electrolyte is toxic and volatile. In the event of an electrolyte leak or if an unusual odour is detected, avoid contact with the leaked liquid or vapour. Non-professionals must not approach the area; contact a professional immediately for handling. Professionals should wear safety goggles, rubber gloves, a gas mask and protective clothing, switch off the equipment immediately,

	remove the leaking battery, and contact a technical engineer for resolution
	The battery is a sealed system and will not release any gases under normal operating conditions. However, in cases of extreme misuse—such as exposure to fire, puncture, crushing, lightning strikes, overcharging, or other conditions that may lead to thermal runaway—the battery may rupture or undergo abnormal internal chemical reactions, resulting in electrolyte leakage or the generation of gases such as CO and H ₂ . Ensure that measures for the venting of flammable gases are in place at the site to prevent combustion or corrosion of equipment
	Gases produced by a burning battery can irritate the eyes, skin and throat; please take appropriate protective measures
	Batteries must be installed in areas away from liquids. It is strictly prohibited to install them beneath locations prone to water leakage, such as unit inlets, ventilation openings, cable exit windows in equipment rooms, or water pipes, to prevent liquid ingress into the equipment causing malfunctions or short circuits.
	During battery installation and commissioning, fire-fighting equipment such as fire sand and carbon dioxide fire extinguishers must be provided in accordance with construction standards and regulations. Prior to commissioning, ensure that fire-fighting facilities compliant with local laws, regulations and standards are in place
	Prior to unpacking the batteries, and during storage and transit, ensure that the outer packaging remains intact and undamaged. Position the batteries correctly in accordance with the markings on the packaging; it is strictly prohibited to place them upside down, on their side, upright, or at an angle. When stacking, comply with the stacking requirements indicated on the outer packaging to avoid any impact or dropping that could result in battery damage or scrapping
	After removing the batteries from their packaging, position them in the required orientation. Do not place them upside down, on their side, upright, at an angle or in a stack. Avoid any impact or dropping that could cause damage or render the batteries unusable.
	Tighten the fastening screws for the copper busbars or cables to the torque specified in this document. Regularly check that they are secure and inspect for rust, corrosion or other foreign matter; clean them thoroughly. Failure to do so may result in loose connections, causing excessive voltage drop or, in the event of high current, excessive heat generation that could burn out the battery.
	After the battery has been discharged, it should be recharged promptly; otherwise, it may be damaged due to over-discharge.

2.4.1 General requirements

The following requirements must be met:

- Before installing, operating or maintaining the battery, please read the instructions provided by the battery manufacturer and comply with their requirements. The safety precautions in this manual are provided as key reminders only; for further safety precautions, please refer to the instructions provided by the battery manufacturer
- Please use the battery within the specified temperature range. Charging is prohibited when the ambient temperature falls below the lower limit of the operating temperature to prevent internal short circuits caused by charging at low temperatures
- Before removing the battery from its packaging, check that the packaging is intact. Do not use batteries with damaged packaging; if damaged, notify the carrier and manufacturer immediately
- Once the battery has been removed from its packaging, installation must be completed within 24 hours. If installation cannot be carried out promptly, the battery must be repackaged and stored indoors in a dry environment free from corrosive gases. Once the energy storage system has been installed, power must be connected within 24 hours. The entire process, from removing the battery from its packaging to connecting power to the energy storage system, must be completed within 72 hours. During subsequent routine maintenance, the battery must not be disconnected for more than 24 hours
- Damage to the battery (such as dropping, impact, swelling, bulging or dents in the casing) may result in leakage or the release of flammable gases. Do not use damaged batteries. If the battery shows signs of damage, such as leakage or structural deformation, please contact the installer or professional maintenance personnel immediately to have it removed and replaced. Do not store damaged batteries near other equipment or flammable materials. Non-professionals should not approach damaged batteries
- Before operating the battery, ensure there are no pungent or burnt odours in the vicinity
- During battery installation, it is strictly prohibited to place installation tools, metal

parts or debris on the battery. Once installation is complete, promptly remove any items from the battery and its surroundings

- Do not install battery packs in wet weather conditions such as rain, snow or heavy fog, to prevent the battery pack from being damaged by moisture or rainwater
- If the battery pack is accidentally exposed to water, do not continue with the installation; transport it to a secure isolation area and dispose of it promptly
- Before installing the battery pack, check that the outer casing is free from deformation or damage
- Check whether the positive and negative terminals of the battery have accidentally come into contact with earth. If this has occurred, disconnect the battery terminals from earth
- Do not carry out welding, grinding or similar work in the vicinity of the battery to avoid the risk of fire caused by sparks or arcs
- If the battery is not to be used for an extended period, it must be stored and charged in accordance with the battery specifications
- Do not use equipment that does not comply with local laws, regulations and standards for charging or discharging.
- During installation and maintenance, the battery circuit must remain disconnected
- Damaged batteries must be monitored during storage to ensure there are no signs of smoke, flames, electrolyte leakage or overheating
- In the event of a battery fault, the surface temperature may become excessively high; avoid contact to prevent burns
- Do not stand, lean against or sit on the equipment

The warning is as follows:

Symbol	Explanation
	To ensure the safety of battery use and the accuracy of battery management functions, please use batteries supplied by our company. We accept no liability for any battery-related faults arising from the use of batteries not supplied by our company

2.4.2 Short-circuit protection

The following requirements must be met:

- When installing or maintaining the battery, the exposed cable terminals must be wrapped with insulating tape
- Prevent foreign objects (such as conductive materials, screws, liquids, etc.) from entering the battery and causing a short circuit

2.4.3 Handling of Leakage

- The electrolyte is corrosive; contact may cause skin irritation and chemical burns. If contact with battery electrolyte occurs, take the following measures:
- Inhalation: Evacuate the contaminated area, breathe fresh air immediately, and seek medical assistance without delay
- Eye contact: Immediately flush the eyes with plenty of clean water for at least 15 minutes; do not rub the eyes, and seek medical attention immediately
- Skin contact: Immediately wash the affected area thoroughly with soap and water, and seek medical attention immediately
- Ingestion: Seek medical attention immediately

3. Product Introduction:

3.1 System Overview:

This product (the ECO-B261LP liquid-cooled energy storage cabinet) is a 261kWh (nominal energy) liquid-cooled energy storage system comprising the following main components: the cabinet housing, the battery system, the liquid-cooling system, the battery management system and the fire suppression system.

This product comprises one battery cabinet energy storage system, consisting of five lithium iron phosphate (LFP) battery packs and one high-voltage cabinet connected in series. Each battery pack comprises 52 3.2V 314Ah cells connected in series, managed by a single BMU (Battery Management Unit), whilst the entire battery cluster is managed by a single BCU (Battery Control Unit), which also uploads battery data and information to the EMS and forwards

data externally via the EMS.



Figure 3-1 Exterior view of ECO-B261LP-2H

3.2 Technical Specifications

3.2.1 Battery Cabinet Design

This liquid-cooled energy storage battery cabinet adopts an integrated design, incorporating key components such as the energy storage battery system, battery management system, fire suppression system and liquid cooling system into a single standard cabinet, facilitating stacking.

The technical specifications of this liquid-cooled energy storage battery cabinet are as follows:

Item	Specification	Remarks
Battery Type	LFP 314Ah	

System Configuration	1P52S*5	
Nominal Energy	261.248 kWh	100% DOD, 0.5P, 25±2° C
Rated Voltage	DC 832 V	
Voltage range	DC 728 – 936 V	Cell voltage 2.8V – 3.6V
Rated charging power	125 kW	(DC side)
Rated discharge power	125 kW	(DC side)
Energy conversion efficiency	≥94%	Excluding the energy storage cabinet itself Auxiliary power consumption
Auxiliary power supply (voltage range)	AC 230 V, 50 Hz	
Operating temperature	-25 to 55° C	
Relative humidity	0 – 95% RH, non-condensing	
Operating altitude	≤ 4000 m	Derated above 2000 m
Cooling method	Active liquid cooling	
Fire protection method	Cabinet-level aerosol + water sprinkler	
IP rating	IP55	
Corrosion Resistance	C4	
Colour	RAL 9003	
Dimensions	1050 × 1350 × 2100 mm	W x D x H
Weight	Approx. 2.5 tonnes	
Communication interfaces	Ethernet/RS485/CAN	

3.3 Energy Storage System Exterior Design

3.3.1 Battery Cabinet Design Proposal

The structural design of the battery cabinet primarily encompasses the external form, selection of steel structures, enclosure protection, and cable entry/exit points, as detailed below:

- Battery cabinet external dimensions: 1050 × 1350 × 2100 mm
- The battery cabinet is equipped with effective corrosion resistance, fire resistance, waterproofing, dustproofing (including protection against wind and sand), vibration resistance, UV protection and anti-theft features, ensuring that the cabinet will not fail

due to factors such as corrosion, fire, water, dust or UV exposure

- Fire-resistant features: The cabinet's outer shell, thermal insulation materials, and internal and external finishing materials are all constructed from flame-retardant materials.
- The battery cabinet has an overall protection rating of IP55. Sealing strips are fitted at the points where the cabinet doors connect to the exterior to prevent dust or rainwater from entering the interior during outdoor conditions such as sandstorms or rainfall. This ensures that water does not accumulate, seep or leak from the top of the cabinet, that rain does not enter through the sides, and that water does not seep through the base
- The battery cabinet is dust-proof (wind and sand-proof): standard ventilation filters that are easy to replace are fitted to the cabinet's air inlets and outlets, as well as to the equipment's air inlets, effectively preventing dust from entering the cabinet during strong winds and sandstorms
- The battery cabinet features an anti-vibration design: ensure that the mechanical strength of the battery cabinet and its internal equipment meets requirements during transport and under seismic conditions, preventing faults such as deformation, malfunction, or failure to operate following vibration
- The battery cabinet is UV-resistant: ensuring that the properties of materials both inside and outside the cabinet do not deteriorate due to UV exposure, and that they do not absorb heat from UV radiation

The external appearance of the battery cabinet is shown in the figure below:



Figure 3-2 Front view of ECO-B261LP-2H

3.4 Internal Design of the Energy Storage System

3.4.1 Internal Equipment Configuration

The 261kWh liquid-cooled energy storage battery cabinet comprises five battery packs, integrated into a single cabinet, and includes one fire suppression system and one liquid-cooling system. The layout of the battery cabinet is shown in the figure below:

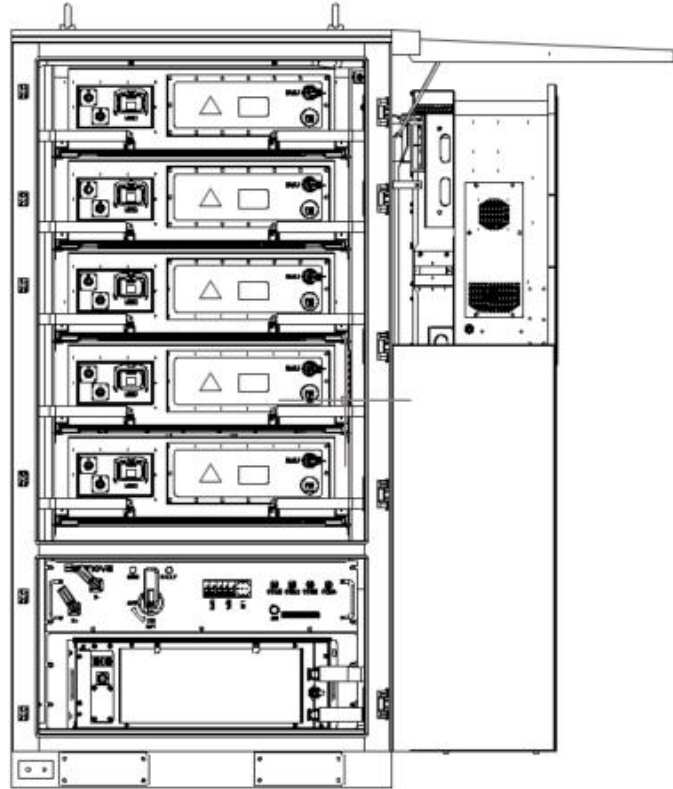


Figure 3-3 Layout diagram of ECO-B261LP-2H

Key component information is as follows:

Component	Quantity	Remarks
Battery Cells	260	LFP 3.2V 314Ah
Battery pack	5	The series-parallel configuration of a single battery pack is 1P52S. In addition to the cells, wiring harnesses and structural components, each battery pack is also equipped with one battery management unit (BMU)
High-voltage enclosure	1	Primarily consists of the main control unit (BCU), EMS, high- and low-voltage wiring harnesses, terminal blocks, auxiliary power distribution components and structural parts
Battery Management System	1	Comprises 5 slave control modules (BMUs) and 1 master control module (BCU)
Fire Protection System	1	Includes one aerosol fire suppression system and one emergency water-based firefighting system
Thermal management system	1	Includes a 5kW liquid-cooled unit
Battery cabinet	1	1050 × 1350 × 2100 mm (W × D × H)

3.4.2 Battery Cells

This design utilises the market-standard 314Ah lithium iron phosphate (LFP) prismatic aluminium-cased cells. The parameters for the individual cells are as follows:

No.	Item	Specification	Remarks
1	Nominal capacity	314Ah	
2	Rated voltage	3.2 V DC	
3	Battery capacity	1004.8 Wh	
4	Maximum charging/discharging power	0.5P	
5	Operating voltage range	2.8V - 3.6V	
6	Charging operating temperature range	0 - 55° C	
7	Discharge operating temperature range	-20 - 55 ° C	
8	Storage temperature	-30 to 60 ° C	
9	Weight	5.6±0.3 kg	
10	Dimensions	174.7 × 207.11 × 71.70 mm	W × D × H

3.4.3 Battery Pack

Based on the dimensions of the battery pack and the selected cells, a configuration of 52 cells is adopted. Each battery pack consists of 4 battery modules, with each module containing 13 cells connected in series, i.e. 1P13S × 4. The battery pack is configured as 1P52S. The battery pack parameters are as follows:

No.	Name	Parameter	Remarks
1	Nominal energy	52.249 kWh	
2	Rated voltage	DC 166.4 V	
3	Voltage range	DC 145.6 - 187.2 V	Cell voltage 2.8V - 3.6V
4	Number of cells	52	
5	Cell configuration	1 in series, 52 in parallel	
6	Rated charging rate	0.5P	
7	Rated discharge rate	0.5P	

8	Product dimensions	780×1140×245 mm	W × D × H
9	Communication Interface	CAN	
10	Protection rating	IP65	
11	Weight	Approx. 352 kg	

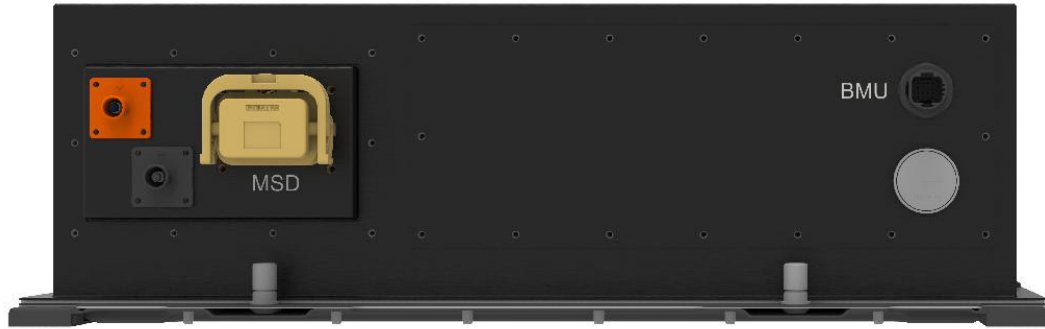


Figure 3-4 1P52S Battery Pack Product Appearance

3.4.3 High-Voltage Cabinet

The high-voltage cabinet is a high-voltage power circuit management unit specifically designed for energy storage systems. It serves as the intermediate unit connecting the battery clusters and the energy storage converter. The high-voltage cabinet performs functions such as monitoring battery cluster voltage and current, controlling and protecting battery cluster circuit contactors, aggregating data uploaded from subordinate Battery Management Units (BMUs), and communicating with the Energy Management System (EMS). The high-voltage control cabinet contains components such as circuit breakers, contactors, fuses, circulating current control circuits, current sensors, the main battery management unit (BCU) and switching power supplies. During its design, full consideration was given to the electrical characteristics, thermal management, safety performance and serviceability of each component. The cabinet features a rational spatial layout and is characterised by a compact structure, flexible configuration and high safety and reliability.

The parameters of the high-voltage cabinet are as follows:

No.	Item	Parameter	Remarks
1	Rated operating voltage	DC 832 V	Complies with the DC 1500 V voltage rating
2	Rated operating current	250 A	

3	Power supply input	AC 220 V	
4	Dimensions	800 × 843 × 201 mm	W × D × H
5	Operating temperature	-25 to 55° C	
6	Operating humidity	≤95% RH, non-condensing	
7	Communication interfaces	CAN, LAN	
8	Protection rating	IP20	
9	Product weight	Approx. 60 kg	

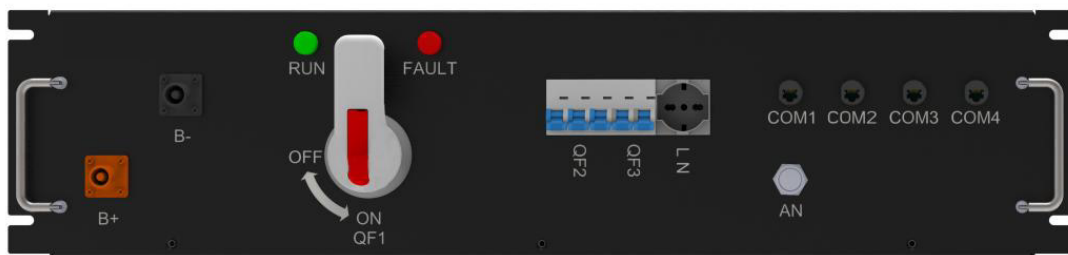


Figure 3-5 Appearance of HVB

3.4.4 Battery Management System

The 261kWh liquid-cooled battery cabinet comprises five battery packs connected in series. Each battery pack is independently managed by a single Battery Management Unit (BMU), which is responsible for collecting and uploading all information from the battery pack, including voltage data from 52 individual cells and temperature data from 20 terminals. The BMU communicates with the upper-level Battery Control Unit (BCU) via the standard CAN 2.0 protocol. Each battery cabinet is equipped with one main control unit (BCU). The BCU uses the standard Modbus TCP/RTU protocol to exchange data with the EMS industrial control computer. The EMS collects data from the liquid-cooling unit (ACU) and the electricity meter (Meter) within the liquid-cooled battery cabinet via RS-485 communication. It communicates with the BCU via LAN (Ethernet) and with the external power control system (PCS) via CAN communication, and provides one passive DO dry contact signal.

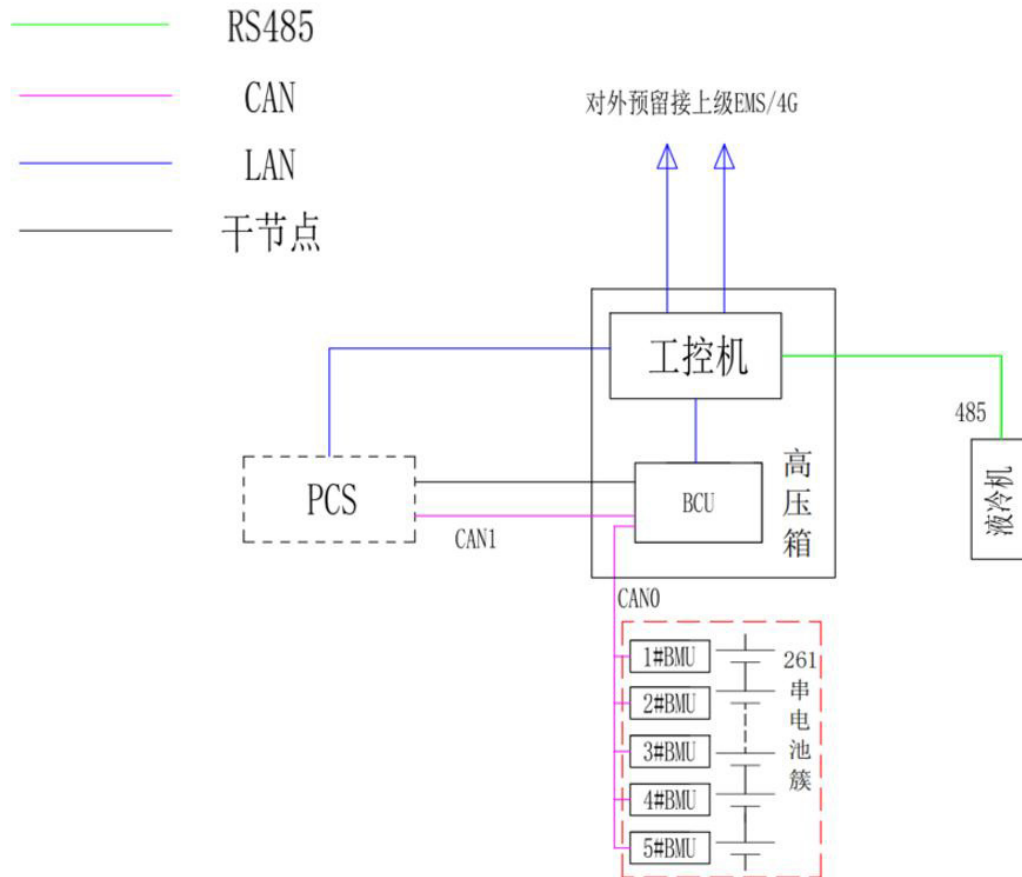


Figure 3-6 BMS Communication Diagram

3.4.4.1 Sub-Control Module (BMU)

The slave control module (BMU) is a slave control module suitable for lithium-ion battery management systems, integrating passive balancing functionality. This module provides real-time monitoring of single-string battery (cell) voltage and temperature, whilst also offering thermal management and passive balancing capabilities. It can be integrated with the main control module (BCU) via CAN communication to form a highly flexible battery management system.

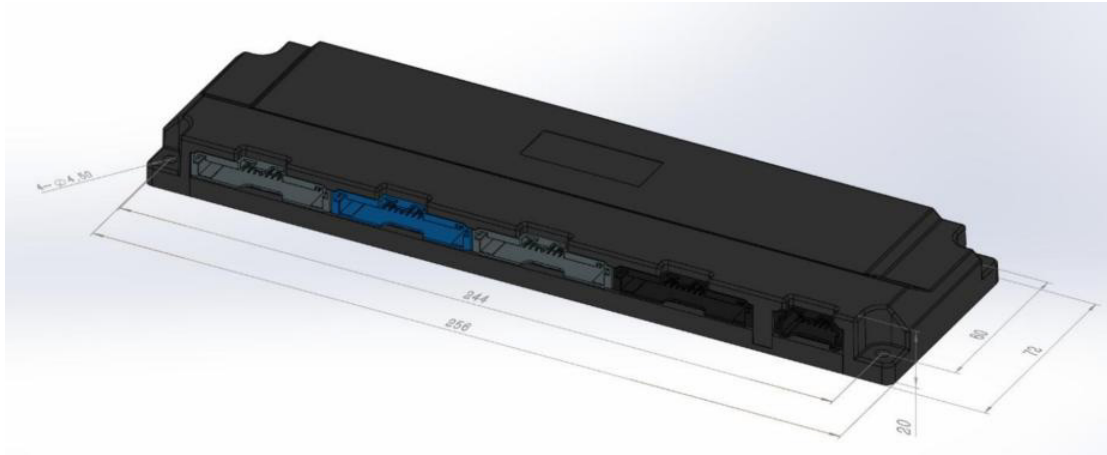


Figure 3-7 BMU External View

Function Description:

- Supports voltage monitoring of 64 series-connected individual cells
- Supports 64-channel NTC (10K) temperature monitoring
- Supports passive balancing using energy-dissipation balancing technology, enabling simultaneous discharge balancing of multiple individual cells within a battery pack; balancing current: 100 mA; the balancing energy of individual cells can be calculated
- Supports low-power mode; the quiescent current in low-power mode can be reduced to 50 μ A or lower
- Supports alarm functions for supply/cell voltage (overvoltage, undervoltage), temperature (over-temperature) and communication faults
- Supports balancing fault detection
- Supports detection of loose connections in the data harness (voltage, temperature)
- Meets the application requirements for 1500V energy storage systems and complies with the functional safety and insulation withstand voltage requirements of standards such as UL 60950, IEC 60730-1:2013, GB/T 36276-2018 and IEC 62477-1:2012; can be provided with relevant certifications such as IEC 62619:2017 and UL 1973.

3.4.4.2 Main Control Unit (BCU)

The Main Control Unit (BCU) is a control and management module designed for energy storage battery management systems. It is primarily responsible for acquiring voltage and current data from battery clusters, aggregating individual cell voltage and temperature information within

the cluster, calculating the cluster's State of Charge (SOC) and State of Health (SOH), executing equalisation strategy assessments and battery fault diagnosis functions, and implementing local protection and relay control for the battery cluster based on fault information. The BCU features a CAN communication interface, enabling data communication with the BMU (Battery Management Unit) and the ESCCU (Energy Storage Control Centre). It is equipped with isolated data acquisition capabilities and functions for calculating individual cell SOC/SOH status, as well as redundant CAN, RS485 and Ethernet communication interfaces for communication with external devices.

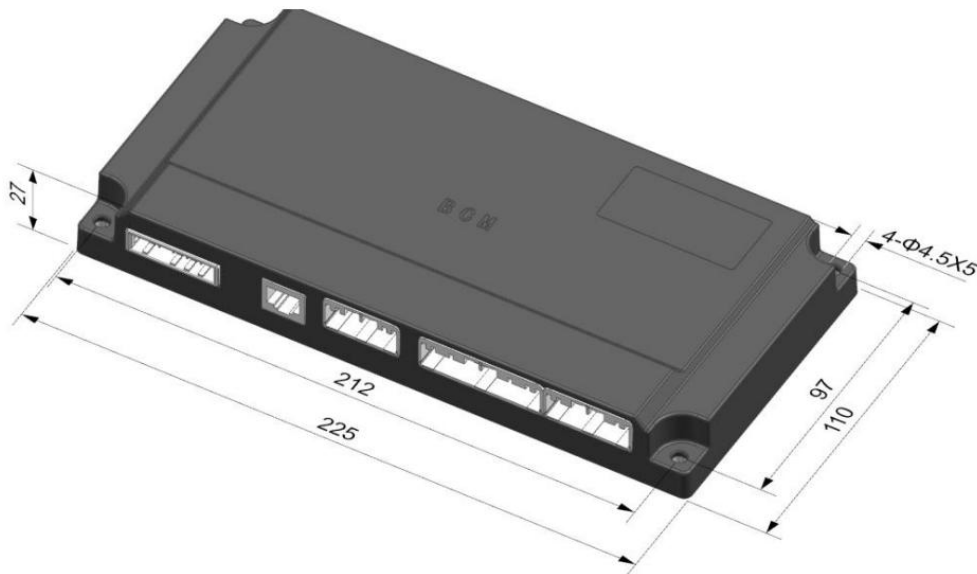


Figure 3-8 Appearance diagram of BCU

Function Description:

- Supports battery status data processing, aggregates real-time battery data, and, following processing, manages and controls the charging and discharging of battery packs/clusters
- Supports string-end voltage detection; by isolating, acquiring and processing string-end voltage data, it enables real-time monitoring of string-end voltage
- Supports pack-end current detection, utilising Hall sensors for real-time isolated acquisition and processing of current data
- Supports battery system insulation detection; this function can be enabled or disabled according to system configuration requirements
- Supports estimation of SOC, SOH, SOE and SOP, enabling the estimation of SOC and SOH for

individual cells and battery packs

- Supports fault detection, including alarm functions based on voltage, current, temperature, SOC, SOH and other thresholds, as well as circuit disconnection protection triggered by extreme alarm thresholds
- Supports system expansion functions, including multi-channel active and passive node outputs, relay control management, and diverse safety control requirements such as effective isolation between high and low voltage circuits
- Supports CAN, RS485 and Ethernet communication protocols to facilitate data exchange
- Meets the application requirements for 1500V energy storage systems and complies with functional safety and insulation withstand voltage requirements of standards such as UL 60950, IEC 60730-1:2013, GB/T 36276-2018 and IEC 62477-1:2012; can be provided with relevant certifications such as IEC 62619:2017 and UL 1973.

Technical Specifications:

Category	Item	Parameter			
		Minimum	Typical Value	Maximum	Unit
Operating power supply	Rated voltage	9	24	32	Vdc
	Rated power consumption	–	–	3	W
5V power output	Rated voltage	–	5	–	Vdc
	Output current	–	–	300	mA
12V power supply output	Rated voltage	–	12	–	Vdc
	Output current	–	–	300	mA
Terminal voltage measurement	Measurement range	0	–	1500	Vdc
	Measurement accuracy	–	±0.1	±0.5	%FS
Terminal current measurement	Acquisition range	0	–	±500	A
	Sampling accuracy	–	±0.1	±0.5	%
Temperature	Number of channels	–	–	4	channels

measurement	Measurement range	-40	-	125	° C
	Measurement accuracy	-	±1	-	° C
Insulation resistance	Measurement range	0	-	10	MΩ
	Measurement accuracy	-	15	-	%
CAN	Number of channels	-	-	1	channels
	Communication rate	125	500	1000	Kb/s
DO	Number of channels	-	-	8	channels
	Output current	-	-	1	A
DI	Number of channels	-	-	2	channels
	DIL	0	-	0.7	V
	DIH	9	-	32	Vdc
CAN	Number of channels	-	-	3	channels
	Communication speed	125	250	1000	Kb/s
LAN	Number of channels	-	-	1	port
	Communication rate	-	10/100	-	Mb/s
RS485	Number of channels	-	-	1	channels
	Communication rate	1200	9600	115200	bps

3.4.5 Fire Protection System

The fire protection system of this product consists of one aerosol fire suppression system and one emergency water fire suppression system.

The aerosol fire suppression system consists of compartment-level components.

Compartment level: The compartment-level thermal aerosol fire suppression system within the battery cabinet utilises point-type smoke detectors and point-type heat detectors as fire detectors, and is equipped with audible and visual fire alarms as well as a compartment-level thermal aerosol fire suppression device to form an automatic fire suppression system.

The emergency water fire suppression system is installed as a last resort to ensure that, in the event of a fire in the electrochemical energy storage facility, the automatic fire suppression system does not fail and fire extinguishment is successfully carried out; it allows

for manual activation of the emergency water supply to extinguish the fire. In this scheme, the emergency water system comprises a water fire suppression piping network installed within the compartment, with connection points provided on the exterior.

Principle of Operation of the Fire Protection System: When either the smoke or heat detectors within the protected area reach the alarm threshold, a Level 1 fire alarm is triggered and a fire signal is output; audible and visual alarms are immediately activated to alert personnel to respond. When both the smoke and heat detectors simultaneously reach the alarm threshold, a Level 2 fire alarm is triggered and a fire signal is output, initiating the discharge phase, during which the thermal aerosol fire extinguishing device activates to extinguish the fire and provides a feedback signal. The specific logic is shown below.

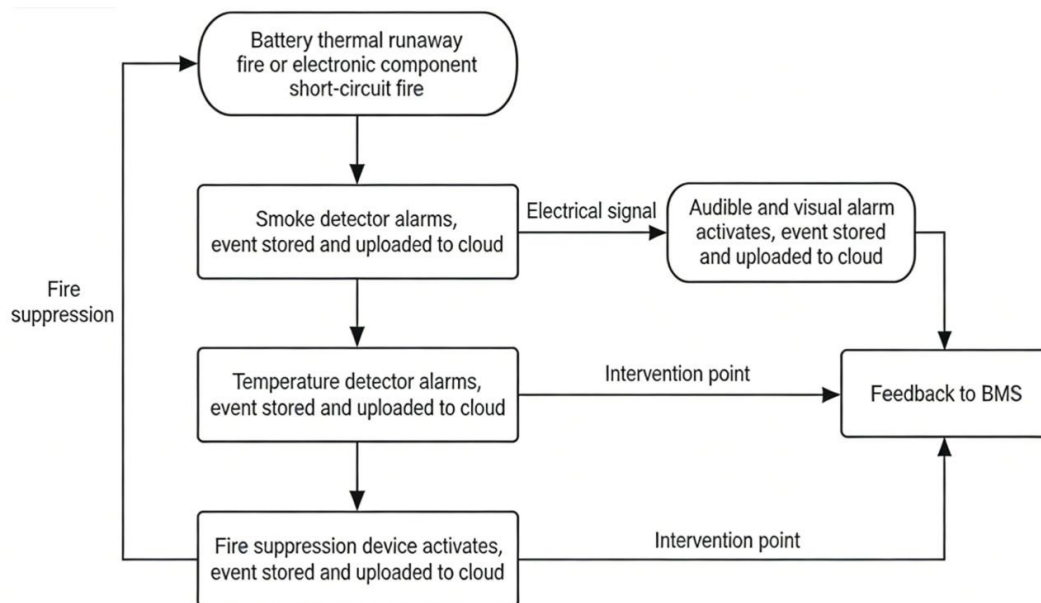
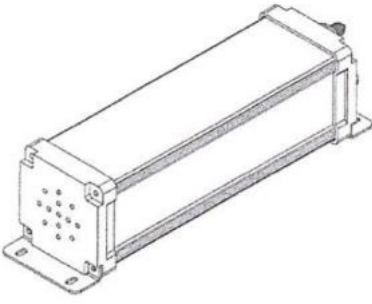


Figure 3-9 Fire protection system logic

The fire protection system configuration is as follows:

No.	Name	Qty	Model
1	Compartment-level thermal aerosol fire extinguishing system	2	JAD QRR0. 15GS-PFK
2	Smoke detector	1	55000-316
3	Heat detector	1	55000-121
4	Detector base	2	45681-200AP0
5	Fire alarm (audible and visual)	1	958CHL1000
6	Water-based fire suppression	1 set	

Fire protection system specifications are as follows:

Smoke Detector 55000-316	Details	Technical Specifications
	Operating Voltage	9 - 33 Vdc
	Standby current	30 - 50 μ A/24 Vdc
	Alarm voltage	6 - 28 Vdc
	Alarm current	52 mA/24 Vdc
	Alarm threshold	0.15 dB/m obstruction
Temperature-sensitive detector 55000-121	Contents	Technical specifications
	Operating Voltage	9 - 33 Vdc
	Quiescent current	55 μ A/24 Vdc
	Alarm voltage	6 - 28 Vdc
	Alarm current	52 mA/24 Vdc
	Operating temperature	AIR: -20 - 50° C
Fire Alarm (Audible and Visual) 958CHL1000	Details	Technical Specifications
	Operating Voltage	9 - 30 Vdc
	IP Rating	IP45
	Operating temperature	-20 - 70° C
	Sound level (dB)	-10 dB / -20 dB
Aerosol Fire Extinguishing Device QRR0.75G-U01	Contents	Technical Specifications
	Activation Method	Electrical activation
	Feedback Signal	Passive digital signal
	Protection Volume	3 m ³
	Discharge time	≤15 s
	Service life	10 years

3.4.6 Thermal Management System

The battery compartment thermal management system employs a liquid cooling system comprising a liquid cooling unit, liquid cooling pipes and pack-level liquid cooling plates. It also utilises a multi-mode, refined thermal management control logic to ensure system temperature and temperature differentials, thereby enhancing system consistency and service life.

The liquid cooling unit and the battery compartment are arranged in a completely independent structural configuration, enhancing system safety. This design utilises a vertical liquid cooling unit operating on an AC power supply, suitable for applications where the internal batteries of energy storage containers generate significant heat and the internal equipment is sensitive to ambient temperature. The liquid cooling unit features an integrated structure, incorporating functions such as communication with the host computer and alarm systems; it offers high reliability and is simple and convenient to install, requiring no complex commissioning. The liquid cooling unit is equipped with variable-frequency compressors and variable-frequency water pumps, enabling dual variable-frequency regulation of both the refrigeration system and the coolant circulation system, thereby achieving high energy efficiency during operation.

The liquid cooling piping employs a two-stage piping scheme, with all pipes utilising nylon flexible hoses that provide insulation, prevent condensation and facilitate air venting. The internal flow channels of the battery liquid cooling plates have undergone thermal flow simulation analysis across all operating conditions. A non-uniform channel design is adopted to ensure uniform flow distribution and eliminate dead zones. The system employs criteria such as temperature differentials across various levels to implement zoned temperature control and intelligently switch operating modes. This reduces auxiliary power consumption and enhances system efficiency whilst maintaining the required temperature differentials.

3.4.6.1 Liquid-cooled Unit

The liquid-cooled unit comprises a compressor, a heater, an internal fan and an external fan system. Its operating mode is as follows:

The liquid-cooled chiller comprises a refrigeration cycle system and a coolant circulation system. The operating process is as follows:

1. Once the outlet liquid temperature reaches the setpoint, the compressor starts and compresses the gaseous refrigerant. The control system of the air-cooled chiller adjusts the speed of the compressor motor in accordance with the outlet liquid temperature or

requirements issued by the host computer, thereby achieving

2. control of the unit's overall power output and liquid discharge temperature
3. The condenser condenses the high-temperature gaseous refrigerant. The gaseous refrigerant is condensed into a liquid, and the heat is dissipated into the surrounding ambient air via the condenser surface by the fan
4. The electronic expansion valve throttles and reduces the pressure of the condensed refrigerant before injecting it into the plate heat exchanger. The refrigerant evaporates within the plate heat exchanger, absorbing heat from the coolant
5. The circulation pump delivers the coolant to the plate heat exchanger, where it undergoes heat exchange with the refrigerant, and then transports the cooled coolant to the energy storage cabinet to cool the battery pack

The parameters of the liquid cooling unit are as follows:

Component	Qty	Remarks
Battery cells	260	LFP 3.2V 314Ah
Battery pack	5	The series-parallel configuration of a single battery pack is 1P52S. In addition to the cells, wiring harnesses and structural components, each battery pack is also equipped with one battery management unit (BMU)
High-voltage enclosure	1	Primarily consists of the main control unit (BCU), EMS, high- and low-voltage wiring harnesses, terminal blocks, auxiliary power distribution components and structural parts
Battery Management System	1	Comprises 5 slave control modules (BMUs) and 1 master control module (BCU)
Fire Protection System	1	Comprises 1 aerosol fire suppression system and 1 emergency water-based fire suppression system
Thermal Management System	1	Includes a 5kW liquid-cooled unit
Battery cabinet	1	1050 × 1350 × 2100 mm (W × D × H)

External dimensions of the liquid-cooled unit are as follows:

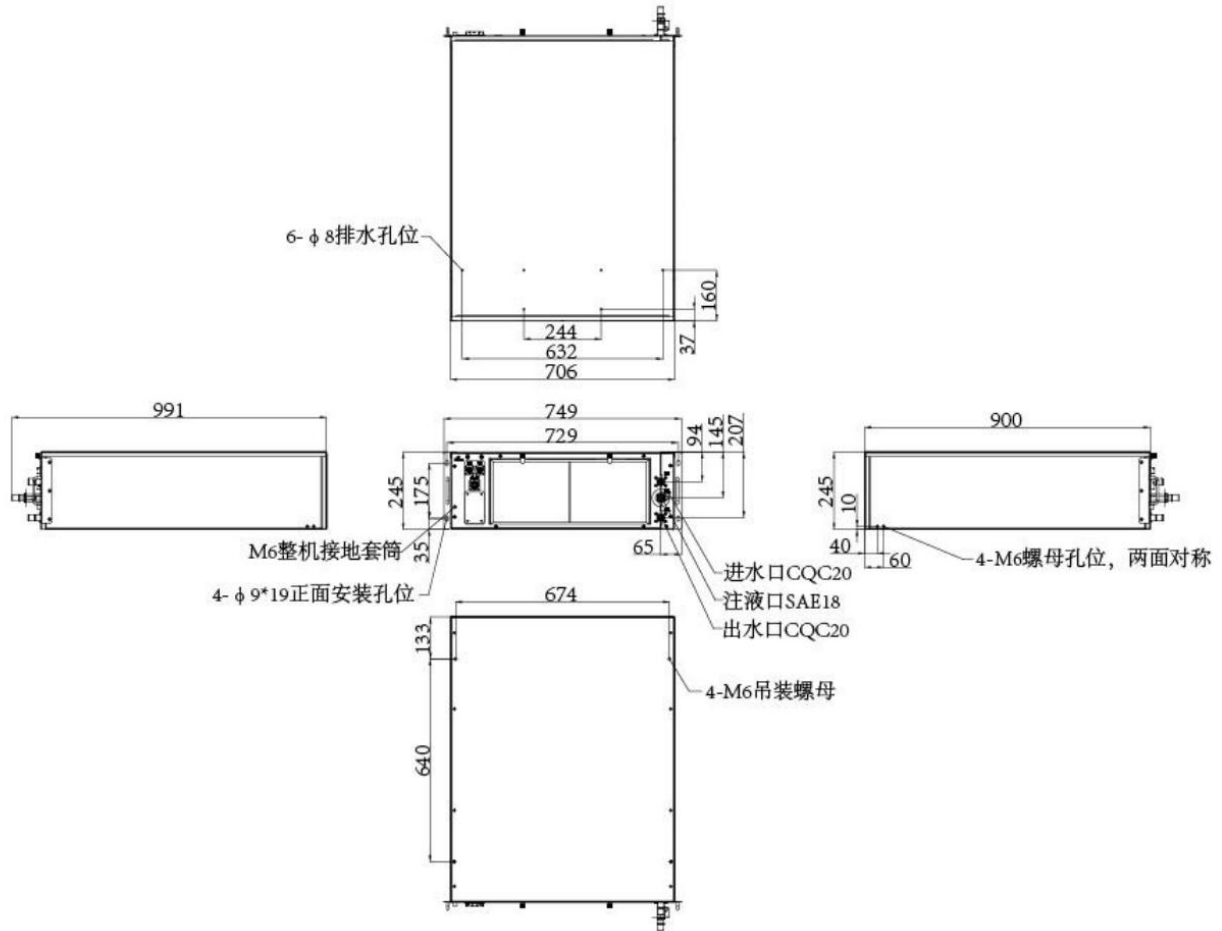


Figure 3-10 Dimensions diagram of the 5kW liquid-cooled unit

3.5 Primary Electrical Schematic of the Energy Storage System

The primary electrical design diagram for the 261kWh liquid-cooled energy storage battery cabinet system primarily covers the DC side and auxiliary power supply circuits.

3.5.1 DC System Primary Diagram

The DC outputs from the five battery packs within the system are consolidated via a high-voltage cabinet into a single main DC circuit, which comprises one DC isolating switch and two DC fuses.

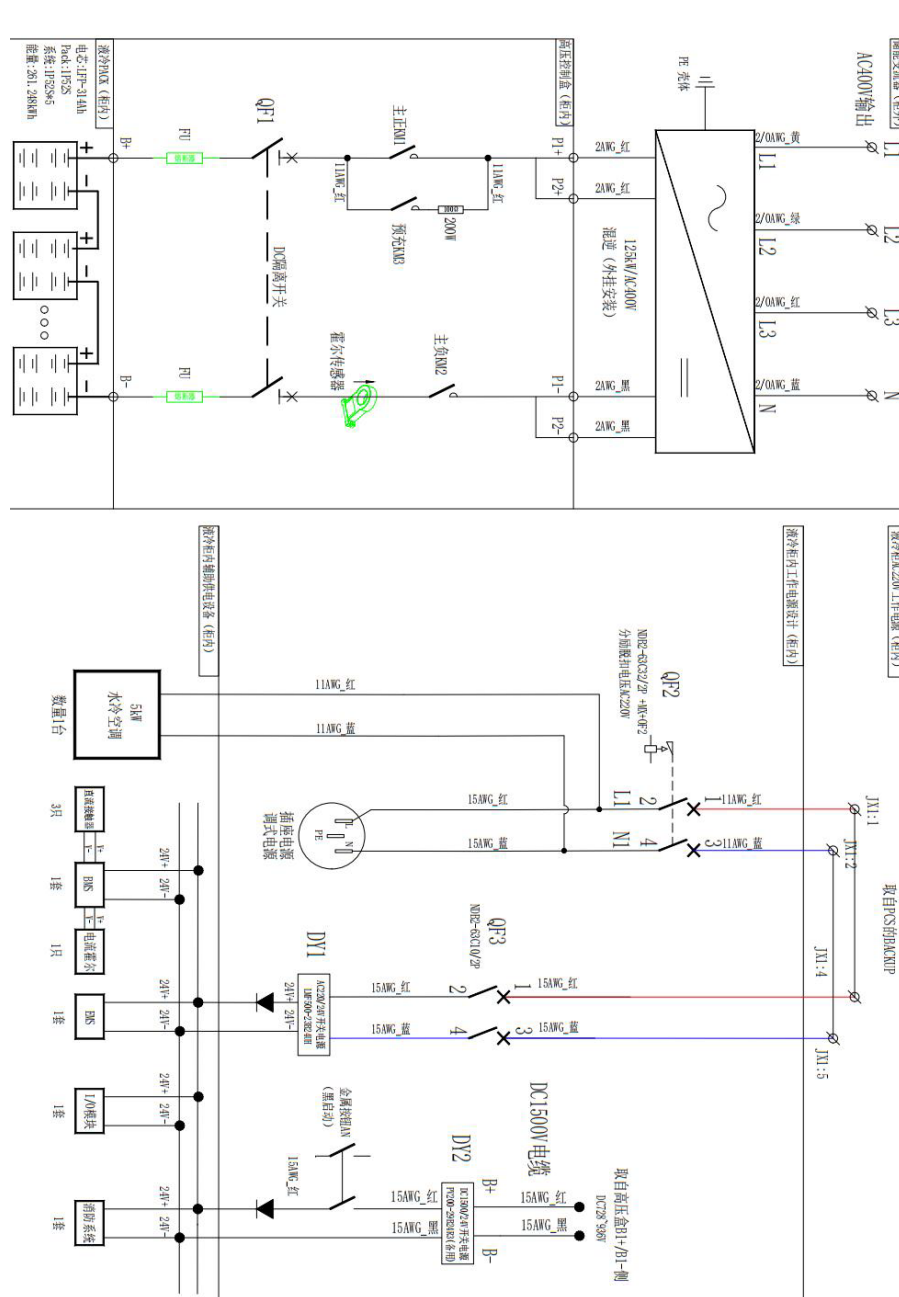


Figure 3-11 Schematic Diagram

4. Lifting, Transport and Storage

4.1 Forklift Requirements

1. If a forklift is used for cabinet installation, the forklift's load capacity must be ≥ 5 tonnes.
2. Recommended fork length: ≥ 1800 mm; width: 230 - 300 mm; thickness: 25 - 80 mm.
3. Forklift lifting height requirements: When the ground level is ≤ 0.3 m, the lifting height must be ≥ 2 m; when the ground level is > 0.3 m, the lifting height must be increased accordingly.
4. Throughout the entire process of transporting the cabinets using a forklift, the forklift's safety operating procedures must be strictly adhered to. As the large dimensions of the liquid-cooled battery cabinets may obstruct the driver's view, an assistant must be present to assist.
5. When using a forklift to lift, lower or move the liquid-cooled battery cabinet, ensure that movements are slow and steady. Furthermore, the liquid-cooled battery cabinet must only be placed on a firm, level surface.
6. If the unpacking location is close to the installation site, the liquid-cooled battery cabinet may be transported by forklift whilst still on its wooden base pallet. Ensure that the centre of gravity of the liquid-cooled battery cabinet is positioned between the two forks of the forklift.

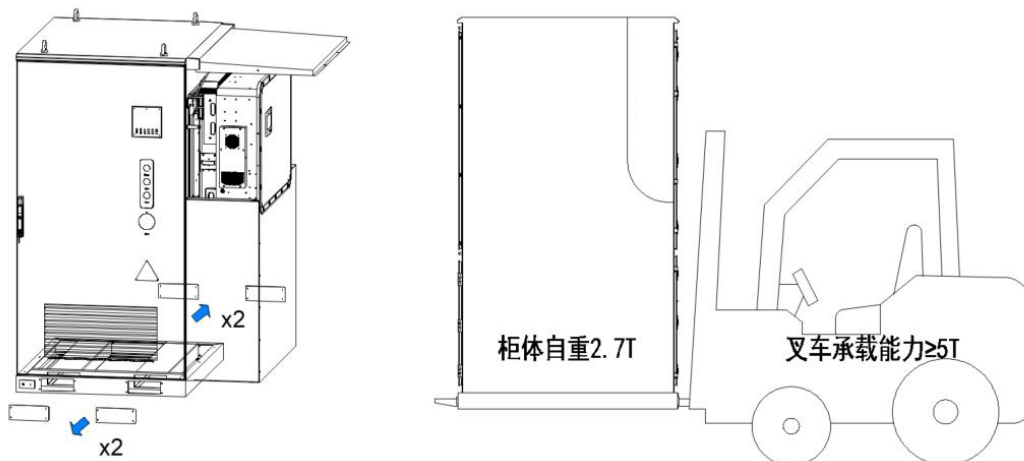


Figure 4-1 Illustration of forklift transport (unpacked cabinet)

7. If the wooden pallet has been removed from the liquid-cooled battery cabinet, it may be transported directly using a forklift; the forks should be placed directly into the slots on the base.
8. To facilitate on-site transport, the fork slots have been pre-designed; the base panels must be removed before transport.

4.2 Lifting Operations

4.2.1 Lifting Precautions

The warning reads as follows:

Symbols	Explanation
 警告	Throughout the entire lifting process, operations must be carried out in strict accordance with the crane's safety operating procedures
 警告	No persons are permitted within a 10-metre radius of the operating area; in particular, no one is allowed beneath the lifting boom or beneath machinery that is being lifted or moved, to prevent accidents resulting in injury or death
 警告	Lifting operations must be suspended in the event of adverse weather conditions, such as heavy rain, dense fog or strong winds

4.2.2 Preparations before Lifting

■ Crane preparation:

The total weight of the equipment is approximately 2.5 tonnes. Please select a crane based on the total weight; a crane model with a capacity of no less than 3 tonnes is recommended

■ Lifting equipment preparation:

Wire ropes, shackles, support poles, etc.

4.2.3 Lifting Procedure

- When loading or unloading goods, a crane with the appropriate lifting capacity must be used. During lifting operations, nylon slings (straps) or steel wire ropes may be used
- The lifting process must strictly follow the lifting diagram; please refer to the attached diagram below for details
- During the lifting process, the battery cabinet must be kept stable, with an inclination

angle of $\leq 5^\circ$

- The entire lifting process should be carried out slowly, with careful attention paid to the balance of the cabinet; movement must not be too rapid
- When moving horizontally, the tilt angle must not exceed 15° .
- No personnel are permitted to stand beneath the battery cabinet or the crane at any point during the lifting operation

4.2.4 Lifting Diagram

A single energy storage battery cabinet system weighs approximately 2.5 tonnes, with external dimensions (W × H × D) of 1050 × 1350 × 2100 mm. Complete the lifting of the battery cabinet in accordance with the relevant instructions in the ‘Battery Cabinet Lifting and Transport Plan’ , and position the battery cabinet at the intended location.

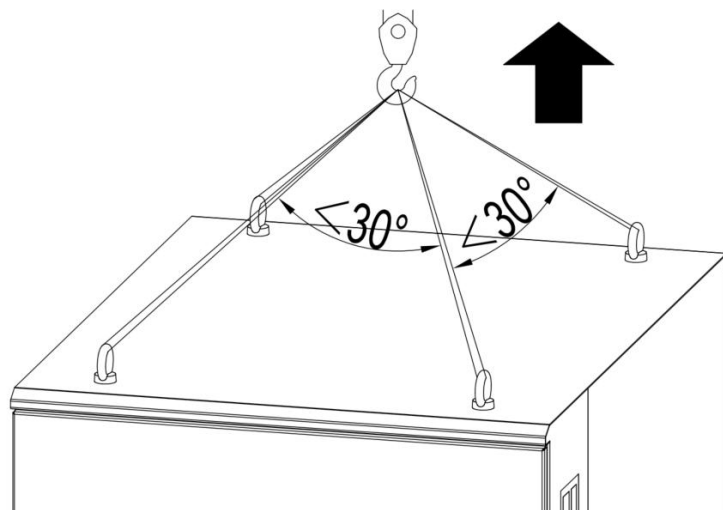


Figure 4-2 Battery Cabinet Lifting Diagram

4.3 Transport

Liquid-cooled energy storage system battery cabinets are suitable for both road and sea transport. During transport, they must be shielded from the sun and handled with care; direct exposure to rain or snow and mechanical impact must be avoided.

4.3.1 Transport Environment Requirements

In accordance with the characteristics of the batteries, the battery packs must meet the

following requirements during storage and transport to maximise the protection of battery performance:

1. Average daily storage temperature: $\leq 20^{\circ}\text{C}$
2. Humidity: $\leq 95\%$, no condensation

4.3.2 Pre-shipment Preparation

- Securing movable parts of the battery cabinet: Cabinet doors and access doors must be secured using mechanical locks combined with strapping tape or cable ties; internal fans, unit components and module brackets, and other parts prone to loosening must be reinforced with bolts or cable ties
- Cover the surface of the battery cabinet with PE protective film / stretch film to prevent scratches to the paintwork
- Fill the space between the cabinet and the outer packaging box with high-density expanded polystyrene (EPS) foam, with a thickness of $\geq 20\text{ mm}$, evenly covering all sides of the cabinet to cushion against transport vibrations.
- For sea transport, MSDS certification must be met, and Class 9 dangerous goods labels must be affixed

■ 4.3.3 Road Transport

- Comply with traffic regulations; the entire transport operation must meet the relevant requirements of UN38.3
- As the battery cabinet contains batteries, speeding is strictly prohibited. On flat tarmac roads, the speed limit on motorways is 70 km/h; reduce speed to 50 km/h on bends. On urban roads, the speed limit is 40 km/h; avoid sudden acceleration and sudden braking
- On uneven tarmac or any other road surface, please drive with particular care and observe a speed limit of 50 km/h
- Transportation on rough, uneven surfaces is prohibited
- Ensure that the goods are securely fastened; check the fastenings once before departure; check the fastenings every four hours during transit

The warning is as follows:

Symbol	Explanation
	<p>Please bear in mind the mechanical parameters of the energy storage system at all times during transport and handling:</p> <p>Dimensions (L × W × H): 1050 × 1350 × 2100 mm</p> <p>Weight: approx. 2 tonnes</p>

4.4 Storage

The system must be stored in a dry warehouse and must not be exposed to direct sunlight or rain. The warehouse must be free from harmful gases, flammable or explosive products, and corrosive chemicals. Avoid mechanical impact, heavy pressure and strong magnetic fields. Keep away from direct sunlight; maintain a distance of at least 2 m from heat sources and at least 50 cm from walls, windows or air inlets.

The following requirements must be met to maximise the protection of the battery' s performance:

1. Average daily storage temperature: $\leq 20^{\circ}\text{C}$
2. Storage humidity: $\leq 95\%$, no condensation
3. Permissible storage temperature: Short-term storage temperature range (within 1 month): -20°C to 45°C ; Long-term storage temperature: 0°C to 35°C

Under these conditions, the following measures are recommended:

1. It is recommended that the battery be discharged and recharged every 3 months to ensure that the State of Charge (SOC) remains within the range of 30% to 50%
2. A capacity verification test and re-inspection must be carried out every 12 months

Warning:

Symbol	Explanation
	<p>Sunpal Co., Ltd. accepts no liability for any damage to the liquid-cooled energy storage system caused by the user' s failure to comply with the storage methods and requirements specified in this manual</p>

5. Foundation Construction

When selecting a site for the foundation, please adhere to the following principles:

1. Due consideration must be given to the climatic conditions and soil geological characteristics (such as stress wave propagation and groundwater levels) at the installation site of this liquid-cooled energy storage system
2. The surrounding environment should be dry, well-ventilated and located away from flammable and explosive areas
3. The foundation soil must possess a certain degree of compaction. It is recommended that the relative density of the soil at the installation site be $\geq 98\%$. If the soil is loose, measures must be taken to ensure the stability of the foundation

6. Equipment Installation

6.1 Installation Instructions

All internal equipment of the liquid-cooled energy storage system has been reliably connected and tested prior to leaving the factory. On-site installation requires the installation and securing of the battery cabinet, connection of the DC-side power cables for the PCS, connection of external signal cables, connection of external auxiliary power supply cables, and earthing of the battery cabinet.

The installation process is illustrated in the figure below:

A detailed description of the installation process is provided below:

Installation Procedures	Installation Description
Pre-installation Preparation	<ol style="list-style-type: none">1. Check the battery cabinet and all functional cabinets for any external damage2. Check the interior of the battery cabinet and all functional cabinets for damaged or loose components3. Confirm that all components are complete and nothing is missing4. Confirm that the installation environment meets the requirements5. Confirm that lifting equipment for the battery cabinet is available on site
Structural installation	<ol style="list-style-type: none">1. Use a crane to move the liquid-cooled energy storage system battery cabinets onto the pre-cast foundations2. Secure the battery cabinets in accordance with project requirements
Electrical installation	<ol style="list-style-type: none">1. Connect the earth points2. Connect the DC-side cables of the PCS, and connect external communication and power cables

6.2 Pre-installation preparations

6.2.1 Check delivery documents

Check against the equipment delivery list to ensure that the quantity of equipment matches the

list.

6.2.2 Checking the equipment

1. Check that the equipment received matches the model ordered
2. Check that the equipment is in good condition, both inside and out, and free from damage
3. If there are any instruction manuals in the packaging, please keep them in a safe place

The following warnings apply:

Symbol	Explanation
	<ol style="list-style-type: none"> 1. Ensure that the installed equipment matches the model actually ordered 2. Ensure that the equipment to be installed is free from any damage

6.2.3 Installation Environment Requirements

The installation environment for the liquid-cooled energy storage system enclosure must meet the following requirements:

Item	Requirement
Installation Site	Ground slope $\leq 1^\circ$, seismic resistance > 8 on the Richter scale
Ambient temperature	-20 to 55°C
Relative Humidity	$\leq 95\%$, non-condensing
Altitude	$< 4000 \text{ m}$

6.2.4 Installation procedure for liquid-cooled battery cabinets

6.2.4.1 Installation and Secure Connection of the Battery Cabinet Enclosure

1. On site, use a crane (recommended lifting capacity of no less than 3 tonnes) to slowly hoist the entire liquid-cooled energy storage system onto the pre-cast foundation. For specific hoisting procedures, please refer to the hoisting operations section in Chapter 6.1 of this manual

2. Select the installation and fixing method for the battery cabinet based on site conditions. The base of the battery cabinet must rest on a concrete foundation of sufficient strength. During installation, adequate support must be provided at the four corner brackets and the

bottom beams of the battery cabinet

6.2.4.2 Battery Cabinet Enclosure Earthing Connections

The bolted fixing points of the battery cabinet must be reliably connected to the non-functional conductive conductors of the entire cabinet. Additionally, the battery cabinet provides two cabinet grounding points in the form of a grounding busbar; the grounding points provided to the user must form a reliable equipotential connection with the non-functional conductive conductors of the entire cabinet. The effective cross-sectional area in the grounding system must be no less than 250 mm². Grounding resistance $\leq 4 \Omega$; connection impedance $\leq 0.1 \Omega$.

There is an internal earthing busbar within the battery cabinet; the earth leads from the battery cabinet and other components are connected to this internal earthing busbar, which is then routed to external earthing equipment.

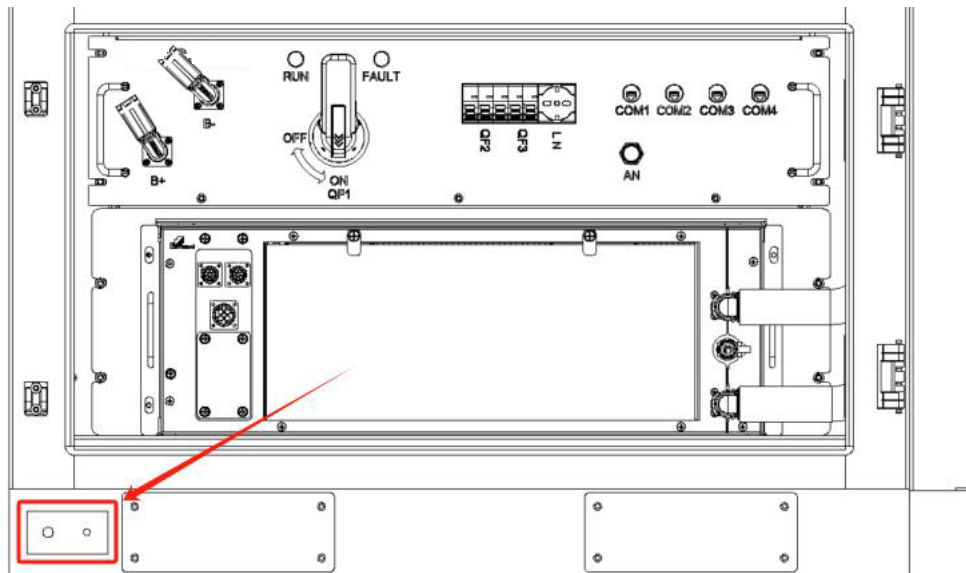


Figure 6-1 Grounding busbar

6.3 Electrical Connections

6.3.1 Electrical Safety Precautions

The warning is as follows:

Symbol	Description
	<p>High voltage hazard! Risk of electric shock! Do not touch live parts!</p> <p>1. Ensure that both the AC and DC sides are de-energised before installation</p>

	2. Do not place the equipment on a flammable surface
	<p>The ingress of sand, dust and moisture may damage the electrical equipment within the energy storage system or affect the operational performance of the equipment!</p> <ol style="list-style-type: none"> 1. During the sandstorm season, or when the relative humidity in the surrounding environment exceeds 95%, electrical connection work should be avoided 2. Commence all connection work only when there is no wind or sand and the weather is clear and dry
	<ol style="list-style-type: none"> 1. Before connecting the wires, check the polarity of all input cables to ensure that the polarity of each input is correct 2. During electrical installation, do not pull on cables or wires with force, as this may damage their insulation 3. Take necessary measures to minimise the stress placed on cables or wires 4. After completing each wiring operation, carry out a thorough inspection to ensure that the connections are correct and secure
	<p>In the event of an external short circuit in the battery cluster circuit or a protective trip of the fuse in the high-voltage cabinet, the fuse in the high-voltage cabinet must be replaced simultaneously</p>

6.3.2 Preparations before wiring

6.3.2.1 Preparation of Installation Tools

The installation tools are as follows:

No.	Tool Name	Illustration
1	Insulated gloves	
2	Safety goggles	

3	Insulated footwear	
4	Workwear	
5	Safety helmet	
6	Screwdriver	
7	Wire strippers	
8	Hydraulic pliers	
9	Hot air gun	
10	Multimeter	
11	Torque wrench	
12	Marker pen	
13	Face shield	

6.3.2.2 Preparing the cable

The selected cables must meet the following conditions:

1. Sufficient current-carrying capacity. The current-carrying capacity of the conductor includes, but is not limited to, the following factors:
 - ◆ Environmental conditions
 - ◆ Type of conductor insulation
 - ◆ Cable installation method
 - ◆ Cable material and cross-sectional area
2. The cable diameter must be selected in accordance with the maximum current-carrying capacity, and sufficient length must be provided
3. All DC input cables must be of the same specification and material
4. The specifications and materials of three-phase AC output cables must be consistent
5. Flame-retardant cables must be selected

The warning is as follows:

Symbol	Note
	The cables used must comply with local laws and regulations. The cable colours shown in the diagrams in this manual are for reference only; please select cables in accordance with local cable standards

6.3.2.3 Schematic diagram of bottom openings in the liquid-cooled battery cabinet

The bottom of the energy storage battery cabinet is equipped with an inlet for the PCS-side DC power cable, an external communication port, and an external auxiliary power supply port.

The detailed cut-out positions are shown in the figure below:

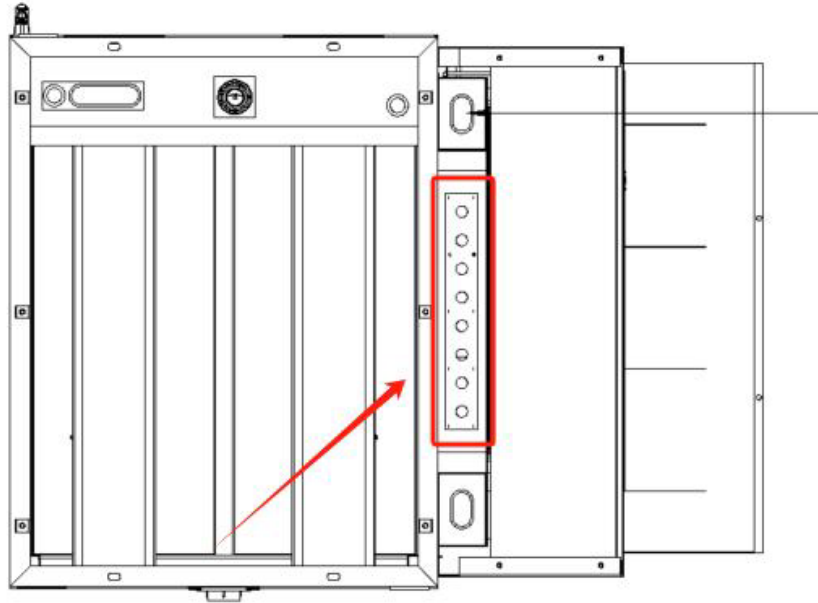


Figure 6-2 Diagram of cable inlet on the side cable tray

6.3.4 Wiring Diagram

1. Communication Interfaces

The battery cabinet is equipped with standardised communication interfaces for external communication, including RS485, CAN and LAN interfaces. Please refer to the table below for details:

No.	Communication Device	Communication Interface	Communication Protocol	Remarks
1	EMS to PCS	LAN, RS485	Modbus	
2	BMS to PCS	CAN		

All internal wiring for the liquid-cooled energy storage system has been completed prior to dispatch, and the external PCS cable harness has been routed to the connection points. Users need only connect the external cables. The external interfaces include DC-side cable connection ports, an external auxiliary power supply interface and external communication ports. Details of the connection ports are shown in the table below:

No.	Function Description	Recommended Cable	Bolt Specification	Remarks
1	DC Output Cable	Single-core flexible copper cable 4' 35 mm ²	ES-BPC-C 35 0G/ES-BPC-C 35 BK	2-channel DC output, 2 wires each for positive and negative
2	AC auxiliary power supply	2 x 2.5 mm ² single-core sheathed cable	M8	1
3	External communication cables (RS485, CAN)	Cat 5e shielded Ethernet cable	RJ45	3

6.3.4.1 DC Cable Connectors

The position and dimensions of the DC cable connectors are shown in the figure below:

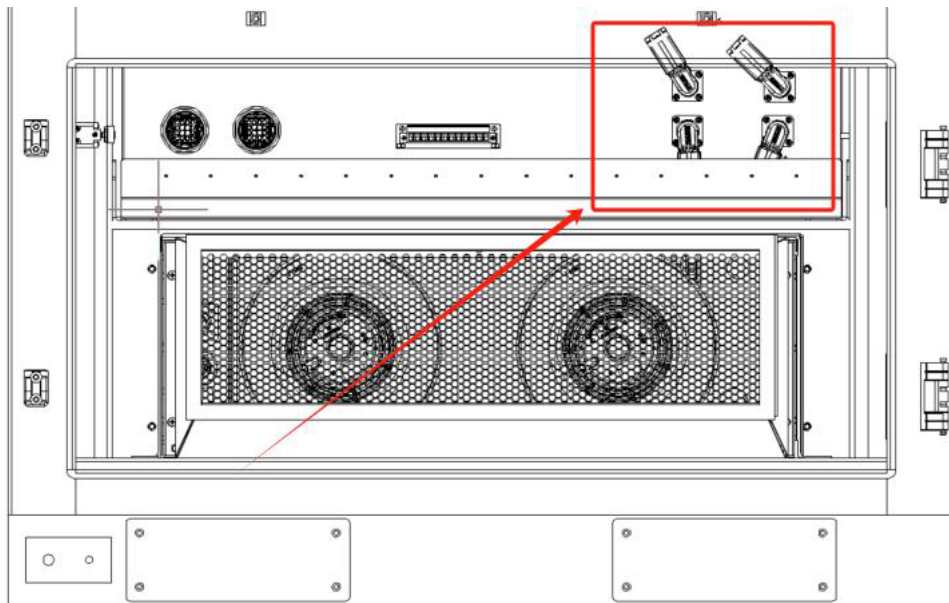


Figure 6-3 Diagram of DC cable connections

The recommended terminal block models for DC cables are shown in the table below:

No.	Item	Description
1	DC cable connection	4 x 1×35mm ² copper-core power cables, 2 DC output circuits, each with 2 power sockets; ensure the locking mechanism is fully engaged until a 'click' is heard:
2	Connector Model	ES-BPC-C 35 0G/ES-BPC-C 35 BK

6.3.4.2 Wiring Procedure for External Auxiliary Power and Communication Cables

- Feed the external auxiliary power supply cable through the cable entry hole in the side of the battery cabinet, and use a screwdriver to connect it to the terminal block provided on the bottom left of the integrated cabinet. Once the connection is confirmed, secure the cable to the corresponding cable tie bracket using nylon cable ties
- Use an RJ45 network cable to connect the external hybrid inverter's communication control interface to the terminal block on the battery cabinet
- Use a shielded network cable to connect the EMS within the battery cabinet to the EMS of the hybrid inverter.

6.3.5 Verification of Cable Connections

1. Before energising the system, inspect all connection cables to ensure that they are securely connected and free from signs of ageing, breakage or insulation damage
2. Check that the positive and negative terminals of the DC power cables are connected correctly
3. Check that the phase sequence of the AC power supply cables is correct
4. Check that all communication cables are correctly and securely connected to the terminals

6.3.6 Post-Wiring Operating Instructions

Once all electrical cable connections have been completed, the following operations must be carried out:

1. Conduct a thorough and comprehensive inspection of all wiring to ensure there are no missing connections or loose connections
2. Seal all cable entry holes and surrounding gaps tightly using fire-resistant and waterproof materials
3. Refit all protective covers securely
4. Inspect the interior of the battery cabinet to ensure no tools or equipment have been left inside

The warning notice is as follows:

Symbol	Description
	<ol style="list-style-type: none"> 1. Failure to seal properly may result in the ingress of moisture and dust 2. Failure to seal properly may result in rodents entering

Once all electrical cable connections have been completed, the following steps must be taken:

1. Refit the removed terminal compartment cover, following the reverse order of removal
2. Once the wiring compartment cover has been fitted, lock the cabinet door, remove the key and keep it in a safe place
3. Finally, lock the electrical compartment door, remove the key and keep it in a safe place
4. The warning is as follows:

Symbol	Description
	<ol style="list-style-type: none"> 1. Ensure that the sealing strips around the cabinet and enclosure doors are free from cracks or damage 2. Ensure that the sealing strips around the cabinet and enclosure doors do not curl when the doors are closed

6.4 Battery Connection

6.4.1 Precautions

6.4.1.1 Risk of electric shock

1. It is strictly prohibited to operate the equipment whilst it is live
2. Ensure that both the AC and DC sides of the equipment are de-energised before installation
3. Ensure that the necessary protective equipment is worn during installation

6.4.1.2 Environmental Considerations

1. Avoid carrying out connection work on the equipment in environments where the relative humidity exceeds 95%
2. Avoid carrying out equipment connection work in environments with high levels of wind and sand

3. Avoid carrying out equipment connection work in environments containing corrosive or flammable gases

6.4.1.3 Wiring Requirements

1. Connect and verify the primary and secondary wiring of the equipment in accordance with the connection diagram

2. Ensure the correct polarity of the cables during wiring to prevent hazards such as short circuits

3. During the connection process, do not pull on the cables with force, to avoid damaging the terminals or compromising the cable insulation

4. After completing each step of the wiring, carefully check that the cables are correctly and securely connected

6.4.2 Cable Connections

- Before connecting power cables, please wear the necessary protective equipment, such as insulated gloves and insulated footwear
- Open the energy storage cabinet door and prepare to connect the battery pack cables. Before connecting the power and communication cables between battery packs, or between a battery pack and the high-voltage cabinet, switch the DC isolator in the high-voltage cabinet to the 'OFF' position

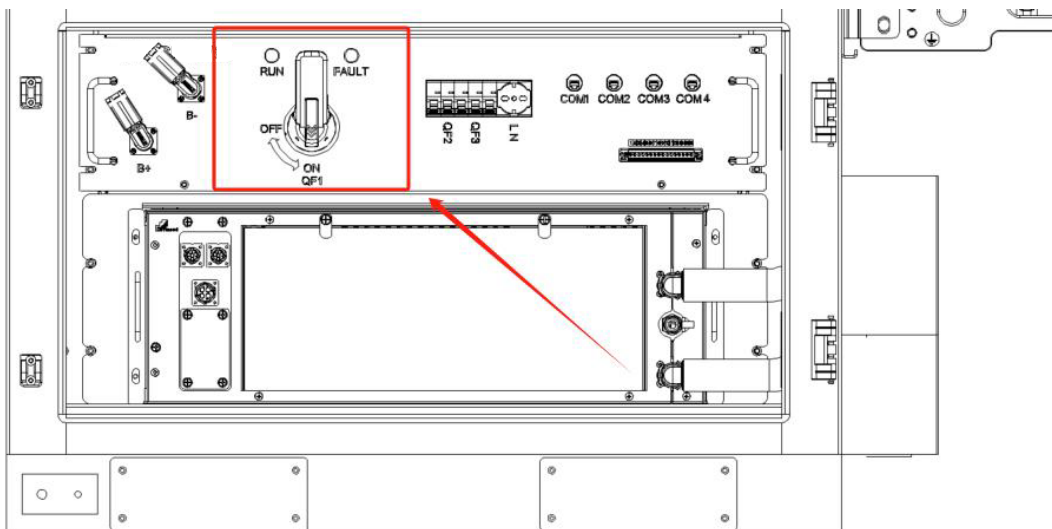


Figure 6-4 Schematic diagram of the high-voltage cabinet switch

- Connecting communication cables between battery packs and between battery packs and the high-voltage cabinet:

1. Insert the communication cable connectors into the COM ports of battery packs 1 to 5 respectively

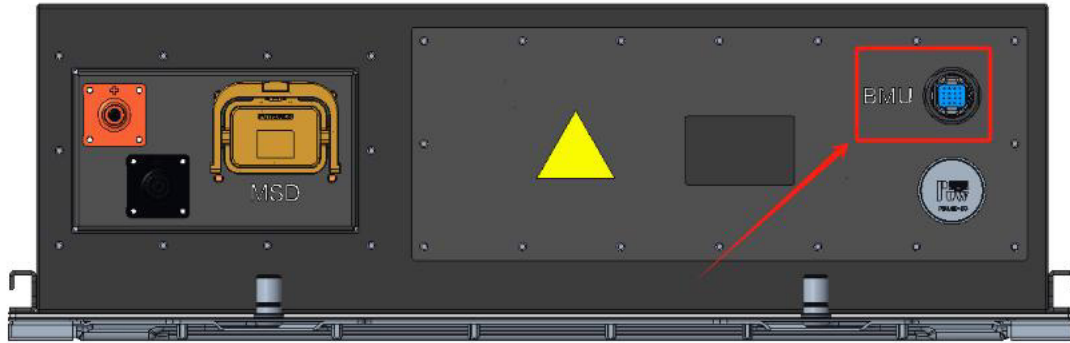


Figure 6-5 Communication interfaces of battery pack

1. Insert the communication cable connectors into the communication ports on the high-voltage box

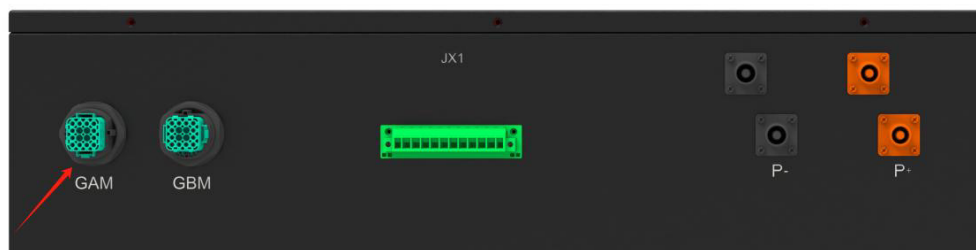


Figure 6-6 Communication interface of high-voltage box

- Power cables connecting between battery packs and between battery packs and the high-voltage box:

1. Connect the positive terminal (B+) of PACK1 to the negative terminal (B-) of PACK2
2. Connect the positive terminal B+ of PACK2 to the negative terminal B- of PACK3
3. Connect the positive terminal B+ of PACK3 to the negative terminal B- of PACK4
4. Connect the positive terminal B+ of PACK4 to the negative terminal B- of PACK5
5. Connect the positive terminal B+ of PACK5 to the B+ terminal of the high-voltage box
6. Connect the positive terminal B- of PACK1 to the negative terminal B- of the high-voltage

box

- Once the wiring work is complete, carefully check all connections to ensure they are correct and secure

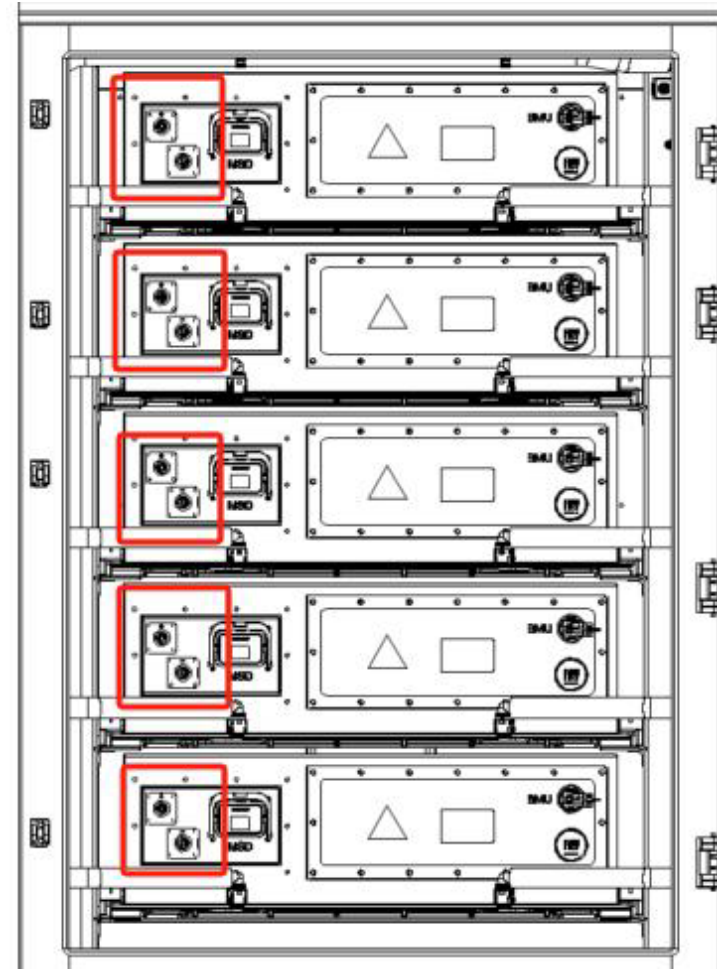


Figure 6-7 Communication and power cable connections between battery packs

The following warnings apply:

Symbol	Description
	<ol style="list-style-type: none"> 1. The positive plug is orange; the negative plug is black 2. The positive terminal of the plug must be inserted into the positive terminal socket, and the negative terminal of the plug must be inserted into the negative terminal socket 3. When the plug is firmly inserted, you will hear a 'click', indicating that the connection is secure

7. Product Operating Guide

7.1 Power-up Procedure for the Liquid-Cooled Energy Storage System

7.1.1 Pre-power-up checks

1. Check that the DC circuit breaker on the high-voltage cabinet panel is in the open position

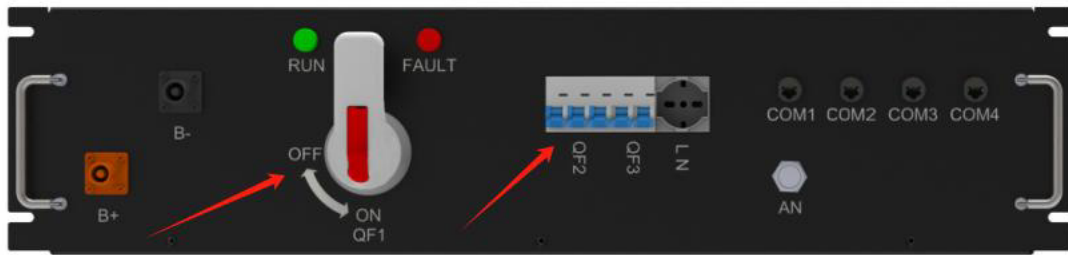


Figure 6-8 Switch status of high-voltage box

2. Check that the series power cables between battery packs and between battery packs and the high-voltage cabinet are securely connected
3. Check that the connection terminals for all communication and power supply cables are securely connected
4. Check that the communication, power supply harnesses and power cables on the high-voltage box panel are correctly connected
5. Check for any issues with the connections of the internal communication and power supply harnesses

7.1.2 Power-up Procedure for the Liquid-Cooled Energy Storage System

- Before power-up, ensure that the isolating switch inside the cabinet is in the off position
1. After connecting to the auxiliary power supply, first close the high-voltage cabinet DC circuit breaker QF1, then close the high-voltage cabinet power supply switch QF2 and the switch-mode power supply switch QF3. At this point, the control system within the battery cabinet is powered up, and the BMS executes the power-up and pre-charge strategy. The high-voltage cabinet status indicator will then illuminate, indicating that the battery system has been powered up, and the status indicator on the battery cabinet door panel will illuminate simultaneously.

2. Once the battery cabinet system has been powered up, close the battery cabinet door.
3. The switch codes and functions are shown in the table below:

No.	Switch	Function
1	QF1	Positive/Negative Switch
2	QF2	High-voltage cabinet supply switch
3	QF3	Switching power supply switch

7.1.3 Power-down procedure for the liquid-cooled energy storage system

- Before de-energising, ensure that the battery cabinet and battery system are in a standby state; it is strictly prohibited to disconnect the power supply whilst the system is under load

1. Open the battery cabinet door and first disconnect the AC power supply switches QF2 and QF3 on the high-voltage cabinet in sequence. At this point, the status indicator lights on the high-voltage cabinet and the white LEDs on the cabinet door panel will go out. Then disconnect QF1 on the high-voltage cabinet to ensure that the main circuit within the high-voltage cabinet is disconnected, thereby completing the de-energisation of the battery system.

7.2 Liquid-Cooled Energy Storage Commissioning Checklist

The commissioning checklist is as follows:

No.	Switch	Function
1	Visual inspection	The enclosure is smooth and the colour is uniform
2		Labelling is clear, and screen printing is complete and accurate
3	Check the screws	Check the screws for looseness, stripped threads, damage, etc.
4	Verify high-voltage connection circuits	Check that the positive and negative terminals of the series power cables between battery packs, and between battery packs and the high-voltage box, are correctly connected and not reversed
5	Start the system	Close the DC circuit breaker on the high-voltage cabinet and the 220V AC supply micro-switch, and check whether the power indicator light on the high-voltage cabinet is illuminated

6	System Self-Test	Check whether there are any alarms during the system self-test
7	Software version verification	Verify the system software version

8. System Policy Description

8.1 BMS System Policies

8.1.1 BMS Power-On/Off and Pre-Charge Policy

Sequence	Action	Logic	Remarks
1	Manually close the circuit breaker in the high-voltage switchboard		BCM level
2	Power up BMS		BCM layer
3	Check circuit breaker feedback	If no Level 3 faults are detected during self-test, proceed to the next step of the power-up sequence	BCM layer
4	Close the main load contactor		BCM layer
5	Close circulating/pre-charge contactor	Voltage detection and decision-making: Directly close the pre-charge circuit; if the HV2+ voltage is $\geq 95\%$ of the total voltage, close the main positive circuit; open the pre-charge circuit after 2 seconds (a timeout of 10 seconds indicates a fault); (Pre-charge resistor: 200W 100 Ω ; PCS capacitance: 3800 μ F)	BCM layer
6	Close the main positive contactor		BCM layer

8.1.2 BMS Trip (Fault Shutdown) Strategy

Sequence	Action	Logic	Remarks
1	A system level 2 alarm is triggered or an external DI signal is detected	The BCM communicates with the PCS via CAN to halt charging and discharging operations, and directly notifies the PCS to shut down via the DO 0 dry contact.	BCM Level

		After a delay of 3-5 seconds, the main positive and main negative contactors in the high-voltage cabinet are opened	
2	Disconnect the contactors within the high-voltage cabinet	Fault cluster: Main positive and main negative contactors in the high-voltage cabinet open (during charging, the main negative contactor opens first; during discharging, the main positive contactor opens first)	BCM layer

8.1.3 BMS Insulation Detection Strategy

Sequence	Action	Logic	Remarks
1	Insulation test	1. Before the main positive and main negative contactors close, the BCM performs an insulation test 2. Once the contactors have closed, the BCM ceases to perform insulation testing; the PCS then takes over	BCM layer

8.1.4 Control Strategy for the EMS Liquid-Cooled Unit

Operating Conditions	Start-up Conditions	Shutdown Conditions
Cooling Strategy	1. When the ESBCM main controller detects that the battery NTC temperature T_{max} is $\geq 35^{\circ}\text{C}$ or the average temperature is $\geq 30^{\circ}\text{C}$, and there is a current of $\geq 10\text{A}$ at the Hall sensor, the liquid cooling unit is activated to commence cooling;	1. If the NTC temperature T_{max} is $< 30^{\circ}\text{C}$ or the average temperature is $\leq 25^{\circ}\text{C}$, the liquid cooling unit stops cooling; 2. When $\Delta T_{max} \geq 15^{\circ}\text{C}$, the air conditioning system ceases cooling (to prevent further deterioration of battery consistency);
Heating Mode	1. When the ESBCM detects that the battery NTC temperature T_{min} is less than 10°C or the average temperature is $\leq 15^{\circ}\text{C}$, heating is activated;	1. When the ESBCM detects that the NTC temperature T_{min} is $\geq 15^{\circ}\text{C}$ (and the average temperature is $\geq 18^{\circ}\text{C}$), the liquid cooler heating is switched off; 2. When $\Delta T_{max} \geq 18^{\circ}\text{C}$, heating is switched off;

8.2 Fire Protection System Strategy

In the event of a fire caused by thermal runaway in a battery cell, the smoke detector first outputs an electrical signal to activate the audible and visual alarms, alerting personnel to take action. The heat detector outputs an electrical signal to activate the fire extinguishing system, initiating fire suppression, whilst simultaneously sending a feedback signal to the BMS board to notify personnel to take prompt action.

8.3 Battery Cabinet Status Indicator Control Strategy

Door Panel Indicator Functions	Operating Conditions	LED Status	Remarks
Power (White light)	AC 220V mains power supply energised; liquid-cooled unit power supply energised. QF2 closed	Off	
	DC/DC power supply energised; 24V control power supplied. QF3 closed	Off	
	Both the AC 220V and DC/DC power supplies are energised simultaneously, i.e. QF2 and QF3 are closed simultaneously.	On	
	AC 220V and DC/DC power supply are not energised; QF2 and QF3 are both in the open position.	Off	
Operating (Green light)	261 kWh liquid-cooled battery cabinet charging status, charging power ≥ 5 kW.	On	
	261kWh liquid-cooled battery cabinet in discharge mode, discharge power ≥ 3 kW.	On	
	261kWh liquid-cooled battery cabinet not in charging or discharging mode	Off	
Fault (Red light)	Temperature sensor alarm signal	On	
	Smoke sensor alarm signal	On	
	Fire sprinkler signal	On	
	Water sensor detects liquid level signal, reaching alarm threshold	On	
	Liquid-cooled battery cabinet charging/discharging power ≥ 5 kW and cabinet door open (normally closed signal)	On	

	BMS third-level charge/discharge alarm (excluding SOC alarm)	On	
	PCS General Fault Bit (EMS displays fault code; confirm fault type): 1. Grid peak overvoltage fault; 2. Grid RMS overvoltage fault; 3. Grid RMS undervoltage fault; 4. Branch 1 peak overcurrent fault; 5. Branch 2 peak overcurrent fault; 6. Branch 1 RMS overcurrent fault; 7. Branch 2 RMS overcurrent fault; 8. DC fuse failure; 9. Emergency stop fault; 10. DC-side overvoltage fault; 11. DC-side undervoltage fault; 12. Large deviation in positive and negative busbar voltages; 13. DC overcurrent fault; 14. Battery short-circuit fault; 15. High grid frequency fault; 16. Low grid frequency fault; 17. Grid phase sequence fault; 18. Grid phase loss fault; 19. Reverse battery polarity fault; Reserved (for parallel operation); 20. Module external CAN communication fault; 21. EEPROM read/write fault; 22. Module IGBT overtemperature fault; 23. Hardware overcurrent fault; 24. Excessive zero-sequence circulating current fault; 25. Instantaneous overcurrent fault on the grid side; 26. AC pre-charging fault; 27. DC pre-charge fault; 28. High-voltage closing failure; 29. Contactor status, communication fault	lit	PCS fault bit

	with BMS, communication fault with EMS (operating indicator lit, PCS operational)		
	<p>BMS general fault bit (EMS displays fault code, confirm fault type):</p> <ol style="list-style-type: none"> 1. String-end discharge overcurrent, Level 2 alarm; 2. Battery bank charging overcurrent - Level 2 alarm; 3. Module-end insulation fault (Level 2 alarm); 4. Cell charging overtemperature - Level 2 alarm; 5. Individual cell under-temperature during charging - Level 2 alarm; 6. Excessive cell voltage difference - Level 2 alarm; 7. Excessive temperature difference in a single cell - Level 2 alarm; 8. Fault in DI1, DI2, DI3, DI4, DI5, DI6, DI7 or DI8; 9. Loss of internal network communication; 10. Abnormal cell voltage reading; 11. Abnormal cell temperature reading; 12. Battery limit fault; 13. Project software version parameters do not match; 14. Communication failure with the PCS; 15. PC forced control debugging mode; 16. CAN Hall sensor fault; 17. CAN Hall sensor communication fault; 18. Hardware self-test anomaly; 19. Balancing fault; 20. Communication fault with EMS; 21. Level 2 over-temperature alarm for individual cell discharge; 22. Level 2 low-temperature alarm for individual cell discharge; 23. Rapid temperature rise alarm (Level 	On	BMS fault bit

	2); 24. Communication fault between BMS and air conditioning.		
	EMS General Fault Indicator: 1. IO module fault; 2. 4G router fault; 3. Industrial PC unit fault; 4. Industrial switch fault; 5. IO module communication fault; 6. 4G router communication failure; 7. Industrial switch communication failure; 8. Communication fault with the BMS (indicator light on, PCS operational); 9. Communication fault with PCS (operation light on, PCS operational); 10. Electricity meter communication fault (operation light on, PCS operational)	On	EMS fault indicator
	Battery fully charged or discharged, no Level 3 alarm triggered	Off	Fully charged or discharged state
	261 kWh liquid-cooled battery cabinet BMS Level 1/Level 2 alarm	Off	BMS minor fault status
	261kWh liquid-cooled battery cabinet non-fault status	Off	Non-fault status

9. SOC Calibration Instructions

- As the energy storage system operates over an extended period, SOC errors will progressively increase due to battery self-discharge, manufacturing variations and the accuracy of current measurement. If the energy storage system has not undergone a full charge, full discharge or full charge-discharge cycle for a prolonged period, SOC calibration is recommended to minimise SOC errors
1. SOC Calibration Interval: For peak shaving and load balancing energy storage systems, 3 - 6 months is recommended; for frequency regulation projects, 1 - 3 months is recommended
 2. SOC Calibration Procedure: A standard full charge-discharge cycle test must be performed; the software will automatically carry out the calibration. If this cannot be achieved, a standard full discharge test may be performed; the software will automatically carry out the calibration. If this cannot be achieved, a standard full charge test may be performed; the software will automatically carry out the calibration. If this cannot be achieved, a standard discharge test may be performed, discharging the battery to below 20% where possible, leaving it to rest for at least one hour, and then calibrating via the software settings.

10. Maintenance Guide

Explanation of Common Terms:

No.	Term	Description
1	Normal Operation	Refers to a system that is operational on a daily basis
2	Intermittent operation	Refers to a system that operates at irregular intervals each month and cannot be guaranteed to be operational every day
3	Long-term disuse	Refers to a battery system that has not been started or operated for a continuous period of more than three months

10.1 Precautions prior to maintenance

The warning is as follows:

Symbol	Explanation
	<ol style="list-style-type: none"> Do not open the battery cabinet for maintenance in rainy, damp or windy weather. If this cannot be avoided, our company accepts no liability for any resulting damage. Avoid opening the battery cabinet door in wet conditions, such as rain, snow or heavy fog. Once the door is closed, ensure that the sealing strips around the edges are not curled.
	<ol style="list-style-type: none"> To minimise the risk of electric shock, do not carry out any maintenance or repair operations other than those specified in this manual. If necessary, please contact our after-sales technical support team for maintenance or repairs.
	<ol style="list-style-type: none"> In clear weather, it is recommended that you open the battery cabinet door to ventilate the equipment and remove moisture

10.2 System Operating Requirements

10.2.1 System Usage Requirements for Normal Operation

- Perform battery maintenance on the system once every twelve months to prevent battery damage; refer to 10.4 for specific maintenance procedures.
- Conduct a system inspection every twelve months and maintain inspection records. The

inspection items are as follows:

No.	Item	Method
No.	Is the fire extinguishing system complete and within its validity period?	Visual inspection
2	Are the supply and exhaust ventilation systems blocked?	Visual inspection
3	Check whether the cooling air ducts of the liquid-cooled unit are blocked	Visual inspection
4	Check whether the battery cabinet is deformed, rusted or damaged	Visual inspection
5	Check whether the fixing bolts on structural components are loose or missing	Visual inspection
6	Check whether the high and low-voltage wiring harnesses are loose or damaged	Visual inspection
7	Check that the MSD is intact and securely fitted	Visual inspection
8	Check for damage to the liquid cooling lines	Visual inspection
9	Check for burn marks at high-pressure connection points	Visual inspection
10	Check for any pungent odours in the electrical compartment	Smell
11	Check whether the battery system data is complete	Monitoring workstation
Note: If any abnormalities are detected during the inspection, please report them immediately and contact the relevant personnel to arrange for resolution!		

10.2.2 Operational Requirements for Intermittent Operation Systems

The usage requirements are the same as for the normal operating system.

10.2.3 Requirements for Systems Left Unused for Extended Periods

1. Storage battery SOC range: 15 - 40%. Avoid long-term storage of battery cells at SOC levels below 15%. When the battery system is not in use for an extended period, power-consuming equipment must be disconnected promptly.
2. Perform battery maintenance on the system every three months to prevent battery damage.
3. Before first use, perform at least one full charge to activate the battery system and restore the battery's performance to its optimal state.

Warning:

Symbol	Description
	Leaving the energy storage system unused for extended periods may cause irreversible damage to the batteries; please ensure regular maintenance is carried out

10.3 Maintenance Precautions

Before carrying out maintenance or repair work on the energy storage system, the DC isolating switch on the high-voltage cabinet must first be disconnected to ensure that the DC isolating switch is in the ‘OFF’ position and the AC auxiliary power switch is open. Once the maintenance or repair work has been completed, ensure that the DC isolating switches on all high-voltage cabinets are in the ‘ON’ position and the AC auxiliary power switches are closed.

10.4 Battery Maintenance

- To ensure the long-term safe and reliable operation of the liquid-cooled energy storage system, please observe the following
 1. When the battery needs to be stored for an extended period, it must be charged to 15 - 40% SOC.
 2. During long-term battery storage, it is recommended to discharge and recharge the batteries every 3 months to ensure that the battery SOC remains within the 15 - 40% range. It is recommended to check the specific condition of the batteries in the system via the CCU every 3 months; the maximum storage period must not exceed 6 months. Before the system is finally connected to the grid, if the ambient temperature is below 10° C, the system must first be started to regulate the batteries to room temperature (25° C ± 3° C). After standing for ≥10 hours, perform a full charge on the battery cells using a 0.2C current rate, then charge and discharge the product under actual operating conditions.

Warning:

Symbol	Description
	Before performing battery maintenance operations, ensure that the environment is safe, the system is safe, and there are no alarms or faults

10.5 Liquid-cooling system maintenance

10.5.1 Regular inspections

1. Check that the power cables and communication cables for the cabinet units are in good working order;

2. Check that the cabinet unit is operating normally, and that there is a noticeable temperature difference between the air inlets and outlets inside and outside the cabinet when the refrigeration system starts up;

3. Check whether the fans and compressors are operating normally during system operation, and whether there are any noticeable abnormal noises or vibrations;

4. Check the mechanical components for any damage or deformation;

5. Check whether the air intake and exhaust vents for the internal and external circulation, as well as the air intake and exhaust screens on the cabinet' s external protective cover, are blocked;

6. Depending on the air quality of the actual operating environment, please arrange for maintenance personnel to carry out inspections of the cabinet units every 3-6 months.

10.5.2 Regular Maintenance

During operation of the cabinet unit, dust will accumulate on the fins of the heat exchanger, creating thermal resistance that affects heat exchange performance; in severe cases, this may lead to a decline in unit performance. It is recommended that the heat exchanger be cleaned and maintained every 3-6 months; the maintenance interval should be determined based on the level of air pollution in the region and the duration of operation. When cleaning, do not use hot water or organic solvents such as petrol.

11. System Fault Troubleshooting

11.1 Routine Fault Handling

- The liquid-cooled battery cabinet is equipped with comprehensive protection functions. When an abnormal operating condition is detected, the battery system will automatically take appropriate measures to promptly safeguard the energy storage system and its sub-components, ensuring the reliable operation of the battery cabinet
- Abnormal operating conditions of the liquid-cooled battery cabinet system are classified as ‘Level 1 Alarm’, ‘Level 2 Fault’ and ‘Level 3 Fault’. A ‘Level 1 Alarm’ triggers no action from the battery system; a ‘Level 2 Fault’ indicates a minor anomaly in the battery cabinet; and a ‘Level 3 Fault’ indicates a serious anomaly. Users may view fault details via the host computer and contact our after-sales service promptly.

11.2 Emergency Fault Handling

11.2.1 Fire

- Evacuate personnel from the site to a safe area, establish a safety cordon, and dial the emergency services depending on the situation
- Provided personal safety is ensured, carry out the following operations where conditions permit
 1. If wiring harnesses are smoking or on fire, use a carbon dioxide or dry powder fire extinguisher to extinguish the fire
 2. If the energy storage battery catches fire, extinguish the fire using a high-pressure water jet from a safe distance
 3. If you accidentally inhale thick smoke, move to a safe area immediately and seek medical attention
- Notify the manufacturer immediately to obtain further instructions
The warning is as follows:

Symbols	Explanation
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If a fire is caused by abnormal charging or discharging, ensure you switch off the power immediately before attempting to extinguish the fire

11.2.2 Flooding

- Regardless of whether the system is powered on, immediately evacuate personnel from the site to a safe area and establish a safety cordon
- Notify the system supplier; repairs shall be carried out once the water has receded
- Do not start the system until the manufacturer has provided a safety assessment

11.2.3 Battery Drop/Impact

- In the event of a distinct odour, damage, smoke or fire, immediately evacuate personnel, alert the emergency services and contact qualified personnel. Qualified personnel must then extinguish the fire using fire-fighting equipment whilst ensuring safety
- If there is no obvious deformation or damage to the exterior and no noticeable odour, smoke or fire, proceed with operations provided safety is ensured

11.2.4 Disposal of Faulty Batteries

- Please dispose of used batteries in accordance with local laws and regulations; do not treat batteries as household waste. Improper disposal of batteries may result in environmental pollution or explosions
- If a battery leaks or is damaged, please contact technical support or a battery recycling company for disposal.
- When a battery has reached the end of its service life and is no longer usable, please contact a battery recycling company for disposal
- Avoid exposing used batteries to high temperatures or direct sunlight
- Avoid exposing used batteries to high humidity or corrosive environments
- Faulty batteries must not be reused; contact a battery recycling company as soon as possible for disposal to prevent environmental pollution

11.2.5 Battery Recycling

- Before attempting to decommission or take the system offline, please contact our after-sales team. Our after-sales team can provide a list of qualified partners in your region

to help ensure the proper disposal of decommissioned equipment

12. Warranty Information

The warranty period is as specified in the commercial contract. During the warranty period, should any component of the product be damaged or fail to meet the contractual specifications due to manufacturing defects or design flaws, the Supplier shall repair or replace the parts free of charge for the Purchaser until the equipment structure is improved and replacement parts are supplied free of charge, except in the following circumstances.

1. Any faults resulting from failure to use, maintain or repair the product correctly in accordance with the provisions of this manual.
2. Damage to the product resulting from water immersion, impact or other damage exceeding its tolerance limits.
3. Unauthorised modification, installation, disassembly or adjustment of the battery system without the authorisation of Sunpal.
4. Damage resulting from the customer's unauthorised handling of a fault in the battery system without Sunpal's permission.
5. Quality issues arising from the use of non-genuine parts not supplied by our company.
6. Damage caused by the use of charging equipment that does not comply with national standards or by improper charging procedures.
7. Neither party shall be liable for damage caused by force majeure, such as earthquakes, typhoons, floods, chemical contamination, lightning strikes, hail, mudslides, falling rocks, fire, political disasters, or deliberate acts of vandalism, nor for any consequential damages arising from such events.